

PITAR RÖMER FROM AUSTRALIAN AND ADJACENT WATERS, WITH
DESCRIPTIONS OF FOUR NEW SPECIES (MOLLUSCA: BIVALVIA: VENERIDAE)

KEVIN L. LAMPRELL AND JOHN M. HEALY

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Twenty seven species of *Pitar* (Veneroidea, Veneridae) occur in Australian waters. All are figured and described, including four new species, *P. (Hyphantosoma) caperi* sp. nov., *P. (Pitarina) queenslandica* sp. nov., *P. (P.) curnowae* sp. nov. and *P. (P.) thornleyae* sp. nov. and one new record *P. (H.) intricata* (Dautzenberg, 1907). *P. (H.) caperi* sp. nov. is also recorded from New Caledonian waters. *P. (Hyphantosoma)* is recorded from Australia for the first time, with five species assignable including three formerly included in *P. (Pitarina)* viz. *P. (H.) spoori* Lamprell & Whitehead, 1990, *P. (H.) nancyae* Lamprell & Whitehead, 1990 and *P. (H.) limatula* (Sowerby, 1853). □ *Mollusca, Bivalvia, Veneridae, Australia, Pacific.*

Kevin L. Lamprell, Malacology Section, Queensland Museum, PO Box 3300, South Brisbane, Queensland 4101, Australia; John M. Healy, Department of Zoology, University of Queensland, Queensland 4072, Australia; 1 May 1997.

Pitar Römer, 1857 occurs worldwide but is especially prolific and speciose in the Indo-West Pacific region and constitutes the largest group of venerids present in the Australian fauna. Although most species prefer shallow-water sandy-mud substrates, some occur among coral sand in reef lagoons or among shell debris in sandy mud to moderate depths (up to or occasionally exceeding 146 metres). Previous studies of Australian *Pitar* s.l. include Lamprell & Whitehead (1990), Healy & Lamprell (1992) and Lamprell & Stanisić (1996) resulting in a total fauna of 16 species. Harte (1993) recorded six fossil and five extant species in *Pitar (Hyphantosoma)*. She noted only one living species from the Western Pacific notably *P.(H.) intricata* (Dautzenberg, 1907) but four from the eastern Pacific — *P. (H.) aletes* Hertlein & Strong, 1948, *P. (H.) hertleini* Olsson, 1961, *P. (H.) pollicaris* (Carpenter, 1864) including one from Tahiti i.e. *P. (H.) festoui* Harte. Harte (1993) emphasized the presence of the fine zigzag sculpture in *Hyphantosoma* (absent in most other pitarines) which prompted a re-evaluation of the subgeneric assignments of the Australian *Pitar*. The present study demonstrates that in addition to *P. (H.) intricata*, Australia has four other species referable to *Hyphantosoma*, three of which were previously included in the subgenus *Pitarina* viz. *P. (H.) spoori* Lamprell & Whitehead, 1990, *P. (H.) nancyae* Lamprell & Whitehead, 1990 and *P. (H.) limatula* (Sowerby, 1853). Zigzag sculpture has also been observed in specimens of *P. (Pitarina) healyi* Lamprell & Stanisić, 1996 from New Cal-

edonia, suggesting perhaps that this species may be more correctly placed within the *P. (Hyphantosoma)* rather than *P. (Pitarina)*. However Harte (1993), while not dismissive of zigzag sculpture as an important feature of the subgenus *Hyphantosoma*, also raised the possibility that such sculpture could have been developed in more than one line of pitarines. In this account *Pitar* is reviewed and an additional five Australian species are described. The subgeneric status of all the species is reassessed in the light of Harte's (1993) review of *P. (Hyphantosoma)*. In addition, specimens of Australian species occurring in adjacent areas (Papua New Guinea, New Caledonia and Fiji) are recorded for the first time.

MATERIALS AND METHODS

Material for this study derives from unsorted or part-sorted lots from the Queensland Museum, Brisbane (QMMO); Australian Museum, Sydney (AMSC); Museum of Victoria (MVF); Western Australian Museum (WAM); South Australian Museum (SAMD); Natural History Museum, London (BMNH); Museum national D'Histoire Naturelle, Paris (MNHN); National Science Museum, Tokyo (NSMT); and from the private collections of G. Curnow, Adelaide, South Australia; P. Spoor, Townsville, Queensland (PS) and one of the authors (KL).

Abbreviations used: lv = left valve; rv = right valve; pv = paired valves; AMS = Australian Museum, Sydney; GBR = Great Barrier Reef; KL = Lamprell Collection, Brisbane; MV = Museum

of Victoria; NEQ = northeastern Queensland; NSW = New South Wales; NT = Northern Territory; PNG = Papua New Guinea; Qld = Queensland; WA = Western Australia;

Shell height given is from the umbo to the ventral margin on the lv. Shell length given is the greatest distance from anterior to posterior margin. Shell width given is the greatest distance between the surfaces of the conjoined left and right valves. Shell size given is for the largest specimen examined by the authors unless otherwise stated.

Subgeneric divisions of *Pitar* as recognized by Keen (1969) in the Treatise on Invertebrate Paleontology, are used in the present study. All dimensions given in figure captions are shell length.

SYSTEMATICS

Family VENERIDAE
Subfamily PITARINAE

Pitar Römer, 1857

DIAGNOSIS. Shell ovate to subtrigonal and moderately inflated; umbones situated anteriorly; shell surface smooth or with obsolete concentric sculpture sometimes developed into zigzag patterns; lunule well defined; escutcheon obsolete.

Pitar (*Hyphantosoma*) Dall, 1902

TYPE SPECIES. *Cytherea carbacea* Guppy, 1866, by original designation.

DIAGNOSIS. Sculpture of zigzag chiseled sculpture on at least part of the external surface of the shell.

Pitar (*Hyphantosoma*) *intricata*
(Dautzenberg, 1907) (Fig. 1A,B; 8A)

Meretrix (*Pitar*) *intricata* Dautzenberg, 1907: 333, pl. 6, fig. 1; Harte, 1993: 347, fig. 3d,e; Lamprell & Staniscic, 1996: p. 47, fig. 6g,h.

DIAGNOSIS. Shell large, length to 53mm; solid, inflated. Sculpture of dense concentric ridges crossed by zigzag grooves, weaker medially. Colour light brown-white externally, internally white.

MATERIAL EXAMINED. HOLOTYPE: MNHN, label marked: Coll. types J. de Conch. V 1907 p.333 pl.VI f.I. OTHER MATERIAL. 1lv, AMSC142102, Samarang, Indonesia, 6°58'S, 110°25'E; 1rv, AMSC096751, Poindimié, New Caledonia, 20°56'S, 165°20'E; 1pv, MNHN, New Caledonia, Noumea, 9m;

1rv, AMSC156551, Port Mathurin, Rodrigues I, Mascarene Islands, 19°41'S, 63°25'E, mud and coralline dredgings; 1lv, AMSC123340, South I, Lizard I, GBR, 14°42'S, 145°27'E, outer side of reef; 1pv, PS, western side of Great Palm I, NEQ, 4m, in sand among coral; 1lv, AMSC306568, Cairns Reef lagoon, NEQ, 15°42'S, 142°30'E, 9-18m; 1lv, AMSC142103, Mactan I, Philippines, 10°5'N, 124°0'E, 7-30m, coral; 1rv, AMSC306573, Micronesia, Pohnpei, Caroline I, 6°55'N, 158°15'E, on rocks and broken coral, outer reef; 1lv, AMSC306668, Eel Reef, GBR, 12°24'S, 143°22'E, 4-8m; 1lv, 1rv, AMSC153285, No Name Reef, GBR, 14°40'S, 145°39'E, rubble at bommie base, Dec 1984.

HABITAT AND DISTRIBUTION. Among coral-sand in reef areas, to 18m; ranging from Mascarene Islands, Indonesia, Philippines, Caroline Islands, New Caledonia to northeastern Australia.

REMARKS. *P. (Hyphantosoma) intricata* (Dautzenberg, 1907) is easily recognised by its large size and fine zigzag sculpture. It is similar to *P. (H.) spoori* (Lamprell & Whitehead, 1990) in colour but larger, more inflated with stronger concentric sculpture and less quadrate posteriorly.

Pitar (*Hyphantosoma*) *spoori* Lamprell & Whitehead, 1990 (Fig. 1C-F; 8B)

Pitar (*Pitarina*) *spoori* Lamprell & Whitehead, 1990: 42, 3a-d; Lamprell & Whitehead, 1992: pl. 67, sp. 519; Lamprell & Staniscic, 1996: p. 44, fig. 5e-f.

DIAGNOSIS. Shell length to 35mm; quadrate, thin. Sculpture of dense concentric ridges crossed by zigzag grooves, weaker medially. Colour white, with sparse interrupted brown radial rays; wide brown radial ray covering posterior; escutcheon marked by a few, spaced brown lines; a deep brown spot often occurring beneath the umbones.

MATERIAL EXAMINED. HOLOTYPE: 1pv, AMSC133572, 3-6m, in gutters at top of drop off, N. West tip of reef, N of No.5 Bank Reef, NEQ, 13°40'S, 144°09'E. PARATYPES: AMSC142104, Broadhurst Reef, E of Townsville, NEQ, subtidal, 20 Jul 1975; 2lv, 2rv, QMM019860, Orpheus I, NEQ, subtidal, Jul 1985; 1lv, 2rv, AMSC155847, Michaelmas Cay, off Cairns, NEQ, GBR Boring Exp, May-Jun 1926; 1lv, 2rv, AMSC148161, Mystery Reef, Swain Reefs, NEQ, 4-6m around bommie in lagoon, 12 Jan 1985; 1pv, AMSC155850, Wheeler Reef, NEQ, subtidal; 2rv, AMSC155849, Lizard I, NEQ, 6-17m, in sandy rubble, 10 Dec 1974; 1lv, AMSC155848, Lizard I, NEQ, at base of reef, 9-12m, 11 Dec 1974. OTHER MATERIAL: 1lv, 1rv, AMSC153322, Reef 14-151, GBR, NEQ, 14°55'S, 145°41'E, 8-13m, among sand in coral heads, Dec 1984; 1lv, AMSC306666, Osprey Reef,

Coral Sea, 13°53'S, 146°31'E, 13-17m, Dec 1984; 1pv, AMSC30665, Reef 21-182, Swain Reefs, Qld, 21°22'S, 151°41'E, 10m, Jan 1995; 1pv, KL, Orpheus I, NEQ, in littoral sand near Octopus hole; 1pv, KL, Palm I side of Fantome I, low tide; 1rv, KL, Rudder Reef, NEQ, low tide.

HABITAT AND DISTRIBUTION. Among coral sand and rubble to 17m; ranging from Mascarene Islands, Mauritius, Indonesia, Philippines, Caroline Islands, New Caledonia, Papua New Guinea to northern Queensland.

REMARKS. *P. (Hyphantosoma) spoori* Lamprell & Whitehead, 1990 is quadrate posteriorly compared with *P. (Pitarina) pellucidus* (Lamarck, 1818) and *P. (P.) subpellucidus* (Sowerby, 1851) which are convex, thin and of similar size. *P. (H.) spoori* has a wide coloured posterior ray (no posterior radial ray in *P. (P.) pellucidus*), obscurely coloured on the median and anterior surface (strongly coloured in *P. (P.) subpellucidus*) and lacks the purple spots under the umbones that occur in *P. (P.) pellucidus*. Recent collecting in New Caledonia has produced the first known live-collected specimen of *P. (H.) spoori* (see Lamprell & Staniscic, 1996). Previously, this species was only known from dead shells taken in the littoral zone of northern Queensland (Lamprell & Whitehead, 1990).

Pitar (*Hyphantosoma*) *caperi* sp. nov.
(Fig. 1G,H; 8D)

ETYMOLOGY. For the vessel 'Caper'.

DIAGNOSIS. Shell length to 26.2mm quadrate, thin, inequilateral, anterior end of shell less than one third of maximum length, moderately inflated, light-weight; umbones oblique, approximate, lunule well defined, lanceolate, striate, surrounded by an impressed line; anterodorsal margin short, slightly convex, sloping, narrowly rounded terminally; posterodorsal margin slightly convex, gently sloping, broadly truncate posteriorly; ventral margin widely convex. Shell smooth with microscopic concentric ridges crossed anteriorly and posteriorly by obscure zig-zag grooves; periostracum, thin, white, situated posteriorly and at the ventral margin. Ligament narrow, impressed. Hinge of lv with anterior lateral tooth long, peg-like; anterior cardinal thin, aeline, separated from median cardinal by inverted v-shaped socket; median cardinal solid, triangular; posterior cardinal free, thin, elongate and oblique; posterior lateral thin, parallel to nymph. Hinge of rv with peg-like anterior lateral

tooth; anterior and median cardinals peg-like, narrowly parallel, separate; posterior cardinal oblique, long, bifid; posterior lateral, parallel to nymph. Muscle attachment scars ill-defined, anterior adductor scar teardrop-shaped, posterior adductor scar large, somewhat ovate. Pallial line thin; pallial sinus extending approximately two-fifths towards the shell centre, wide, rounded terminally. Colour white, with interrupted tan-orange zigzag patterning over the whole surface; escutcheon and lunule crossed by tan lines; umbones with two broad, radial, well defined, white rays extending medially, internally white.

MATERIAL EXAMINED. HOLOTYPE: 1pv, AMSC202973, 6m, Little Upolo Cay, NEQ, P. Spoor, Oct 1983; length of shell 22.8mm, height 18.7mm, width of conjoined valves 11.7mm. PARATYPE: 1pv, MNHN, Anse Vata, Noumea, New Caledonia, 3m, Sep 1994; length of shell 26.2mm, height 20.2mm, width of conjoined valves 12.2mm. OTHER MATERIAL: 1pv, PS, same data as holotype; 1rv, N end of Fantome I, Palm Island Group, 1986; 1pv, KL, same data as paratype.

HABITAT AND DISTRIBUTION. Among coral sand to 6m; ranging from northeastern Queensland, Australia to New Caledonia.

REMARKS. *P. (Hyphantosoma) caperi* sp. nov. is similar to *P. (H.) spoori*, *P. (P.) pellucidus* (Lamarck, 1818) and *P. (P.) subpellucidus* (Sowerby, 1851) in shape but can be readily separated from these species by its zigzag sculpture on the external surface (concentric striae only on *P. (P.) pellucidus* and *P. (P.) subpellucidus*). *P. (H.) caperi* lacks the wide, brown, radial posterior ray and wider pallial sinus of *P. (H.) spoori*, while *P. (H.) spoori* lacks the two white radial rays of *P. (H.) caperi*. *P. (H.) caperi* appears to be a rare species. Examination of the extensive Australian Museum collection has failed to establish any further specimens other than those examined in this study.

Pitar (*Hyphantosoma*) *nancyae* Lamprell & Whitehead, 1990 (Fig. 11-L; 8F)

Pitar (Pitarina) nancyae Lamprell & Whitehead, 1990: 45, 3e-h; Lamprell & Whitehead 1992: pl. 67, sp. 526; Lamprell & Staniscic, 1996: p.45, fig. 6a,b.

DIAGNOSIS. Shell length to 36mm, moderately thin. Sculpture of microscopic concentric ridges crossed anteriorly and posteriorly by obscure zig-zag grooves. Colour white, with wide, broken rays of brown; lunule and escutcheon sparsely marked with brown zigzag pattern; umbones pur-

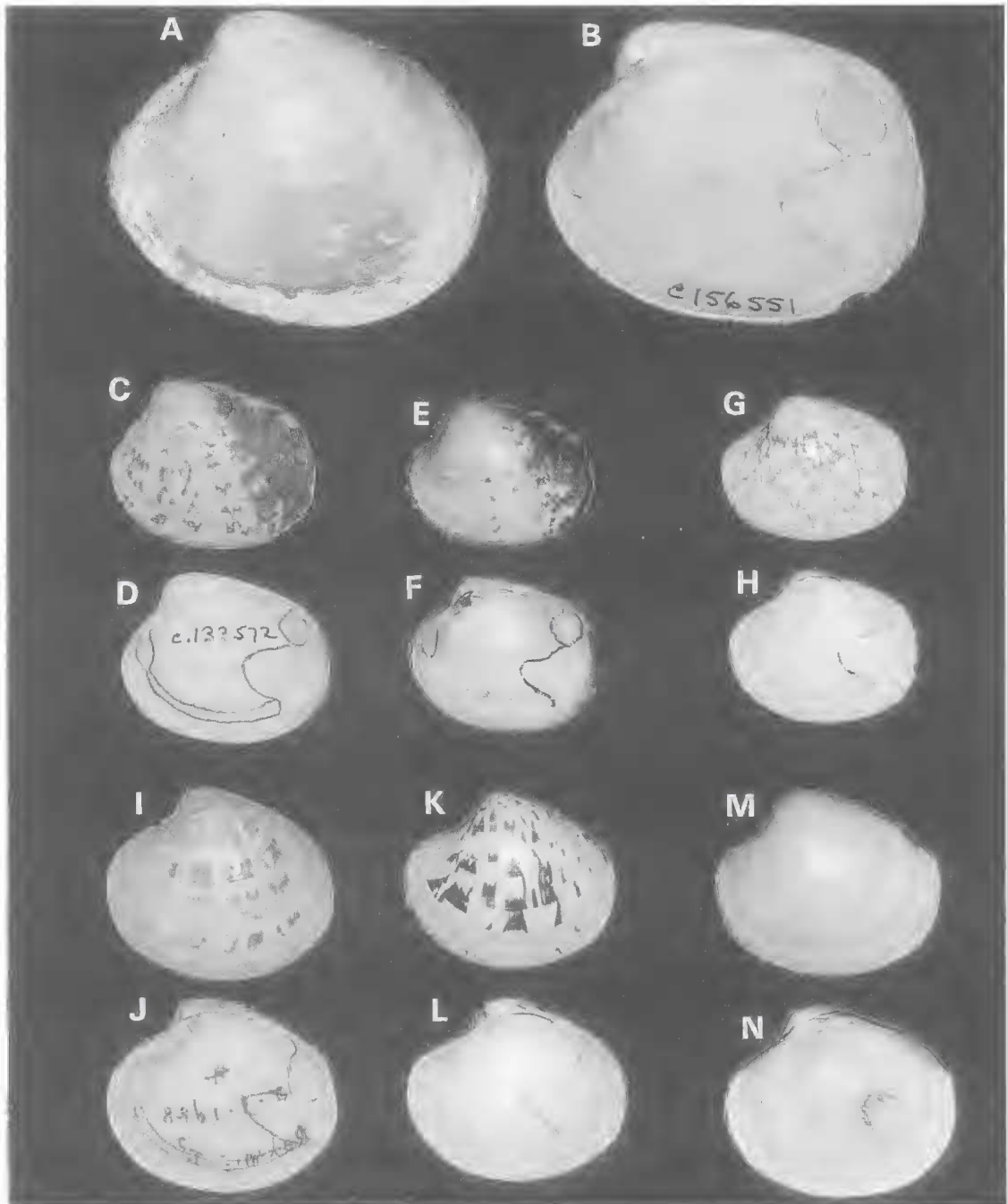


FIG. 1. A, B, *Pitar (Hypantostoma) intricata* (Dautzenberg). A, AMSC123340, Lizard Is, GBR, external lv (enlargement note zigzag sculpture on posterior third of valve), 52.7mm; B, AMSC156551, Mascarene Islands, internal rv (enlargement showing adductor scars and pallial sinus), 37mm. C-F, *P.(H.) spoori* Lamprell & Whitehead. C, D, holotype, AMSC133572, Bank Reef, NEQ, 31mm. C, external lv; D, internal rv. E, F, KL, Orpheus Is, 33mm. E, external lv; F, internal rv. G, H, *P.(H.) caperi* sp. nov., holotype, AMSC202973, Little Upolo Cay, NEQ, 22.8mm. G, external lv; H, internal rv. I-L, *P.(H.) nancyae* Lamprell & Whitehead; I, J, holotype, QMMO22851, Boyne Is, MEQ, 31mm. I, external lv; J, internal rv. K, L, KL, trawled Palm Is, NEQ, 28.8mm. K, external lv; L, internal rv. M, N, *P.(H.) limatula* (Sowerby), KL, Dingo Beach, central Qld, 24.2mm. M, external lv; N, internal rv.

ple tipped; interior white, with a small, intense purple spot inside the umbones.

MATERIAL EXAMINED. HOLOTYPE: 1pv, QMM0-22851, Boyne I, Qld, on beach near mouth of river, at low tide, Feb 1988. PARATYPES: 1pv, AMSC160472, same data as holotype; 1pv, AMSC160473, between Palm I and Curacoa I, NEQ, 10m, sand and rubble; 1pv, WAM940-89, between Palm I and Curacoa I, NEQ, 10m, sand and rubble; 1pv, MVF57680, Boyne I, Qld, in sand among shell debris after strong winds, on beach near mouth of river at low tide, Jan 1988. OTHER MATERIAL: 2rv, AMSC036338, off Murray I, Torres Strait, 9°56'S, 144°4'E, 9-15m, Aug 1907; 1lv, AMSC306543, Dunk I, Qld, 17°57'S, 146°10'E, Aug 1901; 2pv, 1lv, KL, Palm I, NEQ, trawled 10m, Aug 1994; 1pv, KL, Boyne I, Qld, beach, low tide, 1994; 8pv, 1lv, 2rv, KL, Palm I, trawled in Curacoa Channel to 10m; 1pv, KL, Rodds Bay, Turkey Beach, central Qld; 2pv, KL, off Caloundra, Qld, 79m.

HABITAT AND DISTRIBUTION. In sand and rubble to 79m; ranging from central Queensland to the Northern Territory, Australia and New Caledonia.

REMARKS. *P. (Hyphantosoma) nancyae* Lamprell & Whitehead, 1990 has previously been recorded only from the coasts of central to northern Queensland and New Caledonia. In Australia this species usually occurs in depths ranging from 9-30m, however the specimens collected from New Caledonia ranged from 33-60m. *P. (H.) nancyae* is similar to *P. (P.) sophiae* (Angas, 1877) but attains a much larger size and is more solid. This species has been included in *P. (Hyphantosoma)* on the basis of the zigzag sculpture on the anterior and posterior ends.

Pitar (Hyphantosoma) limatula (Sowerby, 1853) (Fig. 1M,N; 8C)

Cytherea limatula Sowerby, 1853: 640, sp. 98, pl. 136, figs 200-201; *Pitar (Hyphantosoma) limatulum* (Sowerby) Habe, 1977: 257; *Pitar (Pitarina) limatula* Lamprell & Whitehead, 1992: pl. 67, sp. 525.

DIAGNOSIS. Shell length to 35mm; solid. Sculpture of fine concentric growth lines crossed by obscure zigzag grooves anteriorly and (rarely) posteriorly. Colour yellow, sometimes lightly flecked or rayed with chestnut-brown; escutcheon and lunule dark chestnut-brown.

MATERIAL EXAMINED. SYNTYPES: 2pv, BMNH 1912.6.4.9-10, locality unknown; 1pv, AMSC306569, Wonga Beach, N of Mossman, NEQ, 16°22'S, 145°26'E, among rocks on sand and gravel;

5pv, 2rv, KL, Dingo Beach, central Qld, washed ashore after cyclone Aivu; 1pv, KL, Cape Upstart, NEQ, beach, 1987; 1pv, KL, Goold I, NEQ, low tide, Nov 1995.

HABITAT AND DISTRIBUTION. Among littoral sand and gravel; ranging from Japan to central and northern Queensland, Australia.

REMARKS. *P. (Hyphantosoma) limatula* (Sowerby, 1853) is readily distinguished from the other Australian *Pitar* species by the conspicuous dark staining on the lunule and escutcheon.

Pitar (Pitarina) Jukes-Brown, 1913

TYPE SPECIES. *Cytherea citrina* Lamarck, 1818 by original designation.

DIAGNOSIS. Posterior cardinal oblique, not attached to median cardinal; pallial sinus short. Sculpture of concentric sculpture only. (Diagnosis here emended).

Pitar (Pitarina) citrina (Lamarck, 1818) (Fig. 2A-C; 8E)

Cytherea citrina Lamarck, 1818: 306; *Chione striata* Gray, 1838: 306; *Dione citrina* Reeve, 1863: pl. 10, fig. 43; *Dione usulata* Reeve, 1863: pl. 11, fig. 49. *Pitar (Pitarina) citrinus* Lamprell & Whitehead, 1992: pl. 67, sp. 520; *Pitar (Pitarina) citrina* Lamprell & Staniscic, 1996: p. 38, fig. 4c,d.

DIAGNOSIS. Shell length to 40mm; solid, inflated, subtriangular to ovate. Sculpture of fine concentric lirae. Colour orange, yellow or sometimes white, with purple posteriorly; interior white with purple centrally and posteriorly.

MATERIAL EXAMINED. HOLOTYPE: Museum de Genève, Lamarck collection, No. 24. OTHER MATERIAL: 7pv, KL, Shark Bay, northern WA, 1987; 4pv, KL, Back Beach, Dampier, northern WA, 1987; 2pv, KL, Broome, northern WA; MNHN, 3pv, Nouméa, New Caledonia; 4lv, MNHN, Platier Ouen Toro, New Caledonia; 2pv, MNHN, Presqu'île Nou Anse Kuenda, New Caledonia.

HABITAT AND DISTRIBUTION. In shallow, loose sand and eel grass; ranging from Japan (Habe, 1977 as *striata*) to north Western Australia, Northern Territory, Australia and New Caledonia.

REMARKS. *P. (Pitarina) citrina* (Lamarck, 1818) is a well known northern Western Australian species where it is found abundantly in loose sand and eel grass in shallow water. Typically it can be identified by its yellow external colour

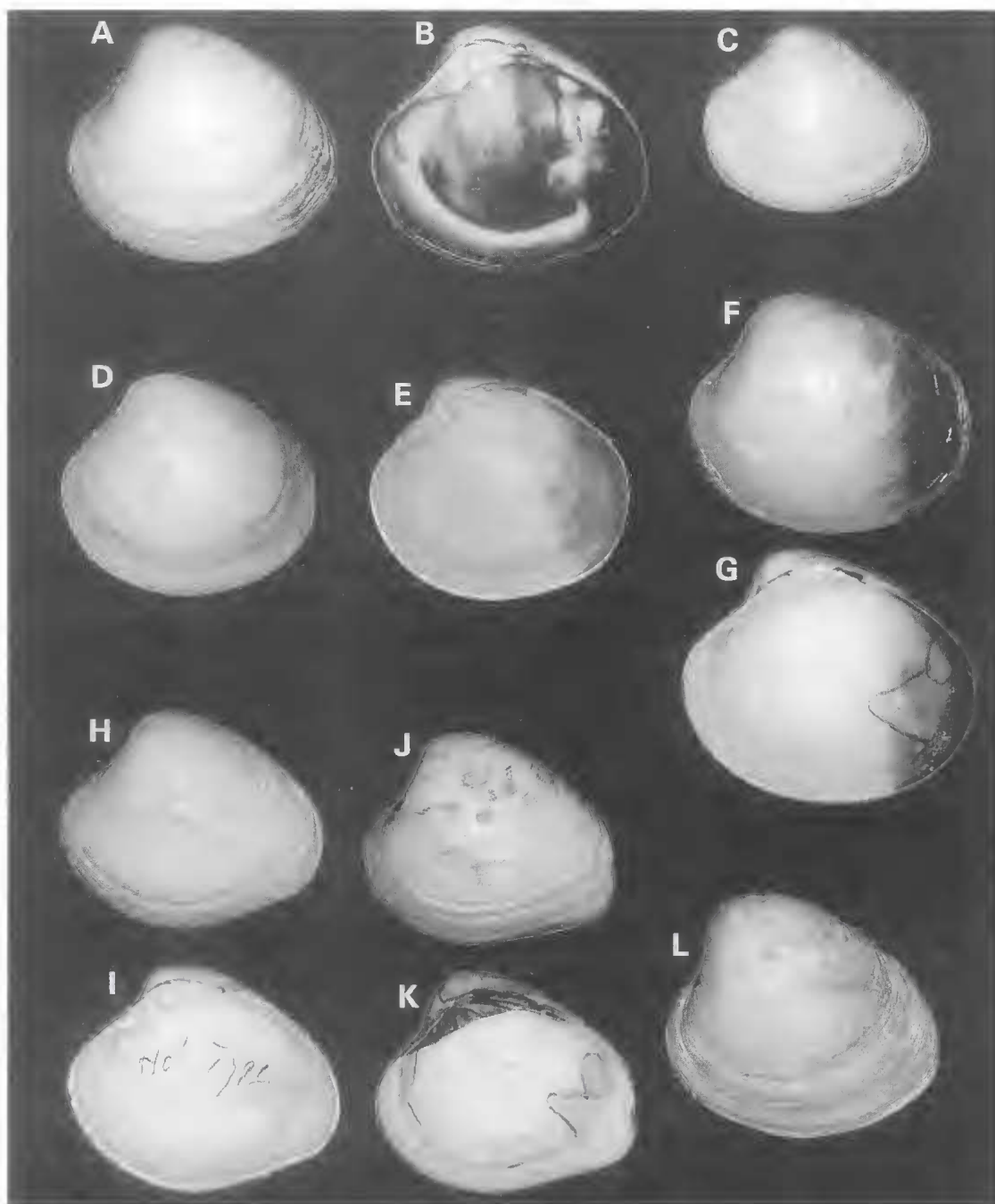


FIG. 2. A-C, *Pitar (Pitarina) citrina* (Lamarck). A, B, KL, Shark Bay, northern WA, 45.4mm. A, external lv; B, internal rv; C, KL, Broome, northern WA, external lv showing coloured rays, 38.5mm. D-G, *P.(P.) marrowae* Healy & Lamprell. D,E, holotype, QMMO32900, Dingo Beach, central Qld, 38.1mm. D, external lv; E, internal rv. F, G, KL, Goold Is, NEQ, 43mm. F, external lv; G, internal rv. H-L, *P.(P.) curnowae* sp. nov. H, I, holotype, AMSC202974, Madang, PNG, 42.7mm. H, external lv; I, internal rv. J, K, KL, Magnetic Is, NEQ. J, external lv; K, internal rv, 50mm (senile specimen). L, paratype, QMMO54081, Little Hope I, NEQ, external lv, 40mm.

(occasionally orange or white) and deep purple internal posterior. Specimens identifiable as *Chione striata* Gray, 1838 and *Dione ustulata* Reeve, 1863 occur sympatrically with *P. (P.) citrina* in northern Western Australia with intergrading shells which show without doubt that they are only forms of *P. (P.) citrina*.

Pitar (Pitarina) marrowae Healy & Lamprell, 1992 (Fig. 2D-G; 8J)

Pitar (Pitarina) marrowae Healy & Lamprell, 1992: 76; *Pitar (Pitarina) cf. osmunda* (Iredale, 1936) *sensu* Lamprell & Whitehead, 1992, pl. 67, sp. 521.

DIAGNOSIS. Shell length to 40mm; thin, inflated, subtrigonal to ovate. Sculpture of fine concentric lirae. Colour cream or fawn, with purple posteriorly; internally cream, with a purple stain at pallial sinus and posterior adductor scar.

MATERIAL EXAMINED. HOLOTYPE: 1pv, QMMO32900, on sandy mud flats at low tide, Dingo Beach, central Qld, 20°05'S, 148°30'E, 1985, KL. PARATYPES: 3pv, QMMO32901, Palm I, 18°40'S, 146°35'E, NEQ, subtidal, 1990; 3pv, AMSC166905, MVF60432, WAM559-91, Palm I, NEQ, 18°40'S, 146°35'E, subtidal, 1990, KL. OTHER MATERIAL: 3pv, KL, Palm I, NEQ, 18°40'S, 146°35'E, subtidal, 1990; 1pv, KL, Slashers Reef No. 1, GBR, 1993; 1pv, 1lv, KL, Goold I, NEQ, Nov 1955; 4lv, 1rv, AMSC306539, E of Moreton Bay, southern Qld, 26°54'S, 153°32'E, 115-176 m; 1rv, AMSC306541, Smith Point, Cobourg Peninsula, NT, 11°07'S, 132°08'E, Jun 1976.

HABITAT AND DISTRIBUTION. Buried in sand and rubble; ranging from New South Wales to northeastern Queensland, Australia, Papua New Guinea, Singapore, Bali, Samoa and the Philippines.

REMARKS. *P. (Pitarina) marrowae* Healy & Lamprell, 1992 differs from *P. (P.) citrina* (Lamarck, 1818) in being a much thinner shell, with a more convex posterior margin. This study has extends the known range to Papua New Guinea, Singapore, Bali, Philippines and Samoa.

Pitar (Pitarina) curnowae sp. nov.
(Fig. 2H-L; 8H)

ETYMOLOGY. For Mrs G. Curnow.

DESCRIPTION. Shell subtrigonal, equivalve, inequilateral with the umbones situated at the anterior third, solid; umbones prosogyrate; lunule well developed, flat, striate, defined by a faint

impressed line; anterodorsal margin short, almost straight, steeply sloping, narrowly convex terminally; posterodorsal margin, long, slightly convex, steeply sloping, convex to truncate posteriorly; ventral margin convex anteriorly, sinuate posteriorly, more pronounced in mature specimens. Shell sculpture of strong, irregular concentric striae and irregular growth pauses. Periostracum, thick, grey, usually with agglutinated sand adhering to the posterior of the shell. Ligament, impressed, olive-brown in colour. Hinge of lv with anterior lateral tooth well developed, peg-like; anterior cardinal thin, joined to thick median cardinal forming an inverted v-shape; posterior cardinal long, ridge-like, free. Hinge of rv with pit for the reception of the lv lateral tooth; anterior cardinal short, narrow; median cardinal thick, straight; posterior cardinal well developed, bifid, oblique. Muscle attachment scars well defined; anterior adductor scar teardrop-shaped; posterior adductor scar larger and more round. Pallial sinus moderately short, ascending, rounded terminally. Shell colouration white or cream-white externally, escutcheon yellow-orange; internally white with yellow colour centrally extending to the posterior muscle scar.

MATERIAL EXAMINED. HOLOTYPE: 1PV, AMSC202974, purchased in market, Madang, PNG. Length of shell 42.7mm, height 35.3mm, width 26.1mm. PARATYPES: 1pv, SAMD18976, in littoral sand, Little Hope I, NEQ, 30 Jun 1988; 1pv, QMMO59380 in littoral sand, Little Hope I, NEQ, 30 Jun 1988; 4lv, 2rv, AMSC105230, 7pv, 2lv, 1rv, AMSC87941, Madang, PNG, 5°12.5'S, 145°47.5'E, swamp behind Nui I, among mangroves, 28 May 1970. OTHER MATERIAL: 1pv, KL, in littoral sand, Magnetic I, NEQ, O. Rippingale.

HABITAT AND DISTRIBUTION. In littoral sand and mangrove swamps; ranging from northern Queensland to Papua New Guinea.

REMARKS. *P. (Pitarina) curnowae* sp. nov is quite variable in shape. Younger specimens have an evenly convex ventral margin while senile specimens develop a concave (sinuate) ventral margin posteriorly and become more obese. *P. (P.) curnowae* is most similar to *P. (P.) citrina* (Lamarck, 1818) in having a similar solid, subtrigonal inequilateral shell but differing in having a sinuate margin posteriorly (evenly convex in *P. (P.) citrina*) and completely lacking any purple posterior colour. *P. (P.) curnowae* lacks the ovate shape of *P. (P.) affinis* (Gmelin, 1791) and the truncate posterior and anterior angulate margin of *P. (P.) prora* (Conrad, 1837) and does not attain

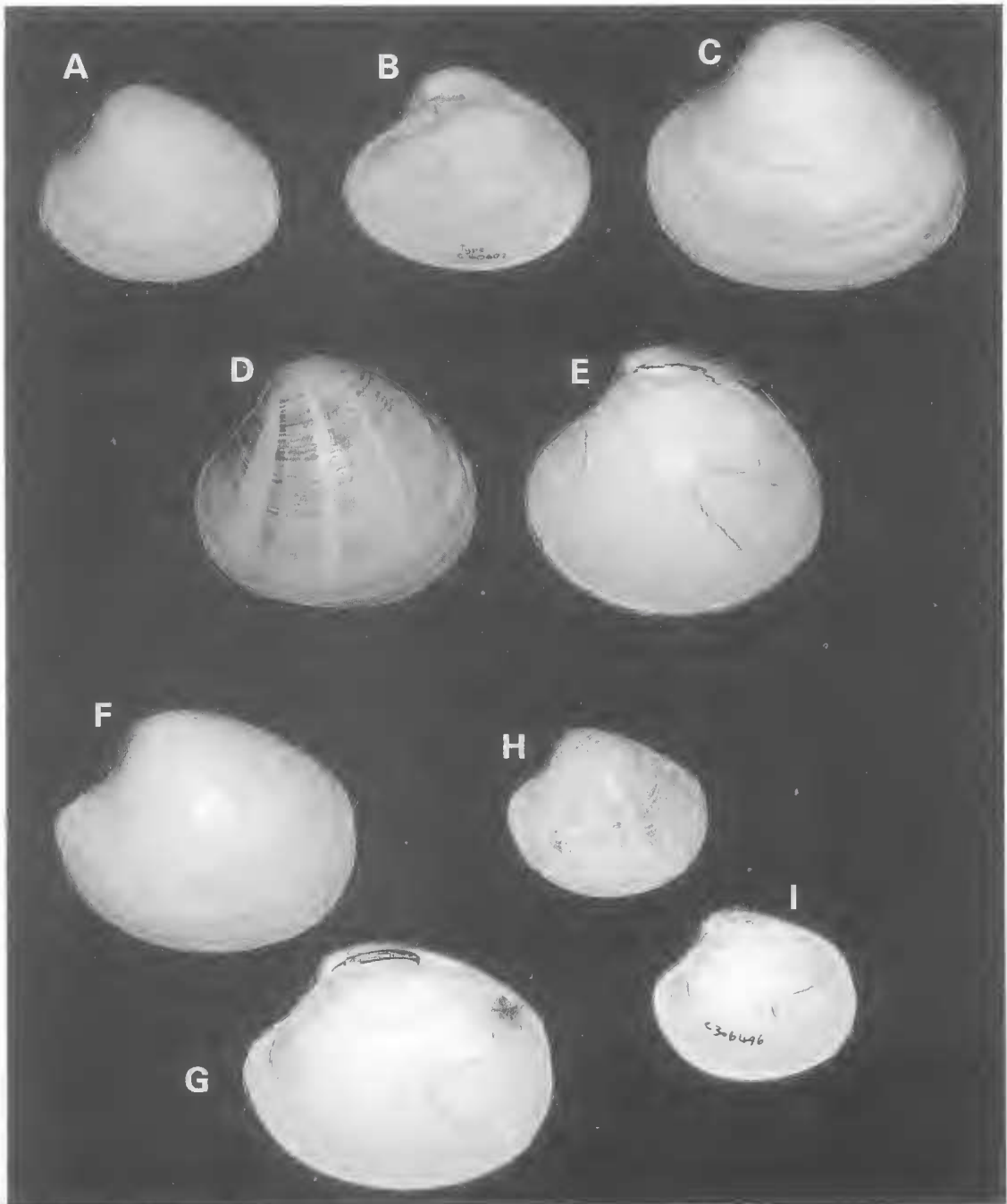


FIG. 3. A-C, *P. (Pitarina) osmunda* (Iredale), Sydney Harbour, NSW. A, AMSC320466, paralectotype, external lv, 39mm; B, AMSC60607, lectotype, internal rv, 38.5mm; C, AMSC303944, external lv, 36.5mm. D, E, *P. (P.) affinis* (Gmelin), KL, Shark Bay, northern WA, 56mm. D, external lv; E, internal rv. F-I, *P.(P.) prora* (Conrad); F, G, KL, North West I, 56.3mm. F, external lv; G, internal rv. H, I, AMSC306496, Mascarene Islands. H, external lv; I, internal rv, 37.2mm.

the large size of these species. *P. (P.) curnowae* lacks the wide convex posterior margin and light zigzag markings of *P. (P.) potteri* Healy & Lamprell, 1992 which is similar in size and valve inflation, but lacks a sinuate ventral margin. *P. (P.) curnowae* differs from *P. (P.) marrowae* in having a more solid shell and in lacking any purple colour posteriorly.

Pitar (Pitarina) osmunda (Iredale, 1936)
(Fig. 3A-C; 8G)

Pitarina osmunda Iredale, 1936: 277.

DIAGNOSIS. Shell length to 39mm; solid, sub-triangular. Sculpture of dense, fine concentric striae and irregular coarser growth lines. Colour dirty white internally and externally.

MATERIAL EXAMINED. LECTOTYPE: 1rv, AMSC60607, Sydney Harbour, NSW. PARALECTOTYPE: 1lv, AMSC320466, same data as lectotype. OTHER MATERIAL: 1lv, AMSC303944, 'Triton Dredge', Sydney Harbour, NSW, 33°50'-33°52'S, 151°12'-151°16'E.

HABITAT AND DISTRIBUTION. Dredged in mud and littoral sand; known only from the type locality, Sydney Harbour, New South Wales.

REMARKS. *P. (Pitarina) osmunda* (Iredale, 1936) is similar to *P. (P.) citrina* and *P. (P.) marrowae* in shape, but lacks the external yellow colour and purple internally and external posterior of both these species. *P. (P.) osmunda* is not as solid as *P. (P.) citrina* and has a more extended pallial sinus.

Pitar (Pitarina) affinis (Gmelin, 1791)
(Fig. 3D,E; 9A)

Venus affinis Gmelin, 1791: 3278; *Pitar (Pitarina) affinis* (Gmelin) Prasad, 1932: 222; *Pitar (Pitarina) affine* Habe, 1977: 257; Lamprell & Whitehead 1992: pl. 67, sp. 514; Lamprell & Stanisic, 1996: p. 42, fig. 5a-b.

DIAGNOSIS. Shell length to 68mm, solid, glossy. Sculpture of fine concentric growth striae. Colour white or cream with tan-brown blotches and rays centrally and towards the umbones, purple spots sometimes occurring beneath umbones.

MATERIAL EXAMINED. 2pv, KL, Port Hedland, northern WA, in littoral sand, 1989; 1pv, KL, Monkey Mia, Shark Bay, northern WA, littoral sand, 1987; 1pv, KL, Capricorn Channel, central Qld, trawled; 4pv, KL, trawled Taylor Reef, NEQ, 10-12m, Dec 1995; 1pv, KL, Palm I, NEQ, 10m, Aug 1994; 5pv, KL, Curacao

Passage, Palm I, NEQ, Nov 1990; 1pv, KL, Dingo Beach, central Qld, in littoral sand; 1pv, KL, Fiji, on beach; 1pv, KL, PNG.

HABITAT AND DISTRIBUTION. In littoral sand and eel grass; ranging from Japan, Philippines, northeast and north Western Australia to New Caledonia.

REMARKS. *P. (Pitarina) affinis* (Gmelin, 1791) is the largest of the *P. (Pitarina)* species found in littoral sand. Examination of the shell middens on Stradbroke Island shows that the species was used as a major food source by the Aboriginal people of the island. *Cytherea inflata* Sowerby, 1851 appears to be a synonym of this well known species.

Pitar (Pitarina) prora (Conrad, 1837)
(Fig. 3F-I; 8I)

Venus prora Conrad, 1837: 253; *Cytherea laeta* Lamarck, 1819: 307; *Cytherea obliquata* Hanley, 1844: 355 (app); *Pitar (Pitarina) obliquatum* (Hanley) Habe, 1977: 257; *Pitar (Pitarina) prora* (Conrad) Lamprell & Whitehead, 1992: pl. 66, sp. 513; Lamprell & Stanisic, 1996: 44, fig. 5c-d.

DIAGNOSIS. Shell length to 65mm; solid; lunule large. Sculpture of even, fine, concentric striae and growth lines. Colour usually white or cream, internally and externally; some specimens develop a fine tan zigzag or chevron pattern over the external surface.

MATERIAL EXAMINED. 1lv, AMSC306669, Port Mathurin, Rodrigues I, Mascarene Islands, 19°41'S, 63°25'E, mud and coralline dredgings; 1pv, 3rv, 2lv, AMSC306496, AMSC306497, Anse aux Anglais, Rodrigues I, Mascarene Islands, 19°43'S, 63°25'E, mud flats, May 1995; 1pv, AMSC306664, Mystery Reef, Swain Reefs, GBR, 21°23'S, 152°01'E, silt in lagoon, 10m, 13 Jan 1985; 1pv, KL, Feather Reef, NEQ, in lagoon; 1pv, KL, Suva, Fiji, in coral sand on reef; 1pv, KL, Apia, West Samoa, on reef flat; 1pv, KL, North West I, Bunker Group, in lagoon, 1991.

HABITAT AND DISTRIBUTION. Among coral sand to 10m and on muddy sand flats at low tide; ranging from Arabia, Tanzania, Madagascar, Japan, Cocos-Keeling Islands, Hawaiian Islands, New Caledonia to the northeast coast of Australia.

REMARKS. *P. (Pitarina) prora* (Conrad, 1837) is the largest and heaviest shell in *P. (Pitarina)*. *P. (P.) prora* is not a common species throughout its range and is easily separated from other members of the genus by its almost pointed anterior

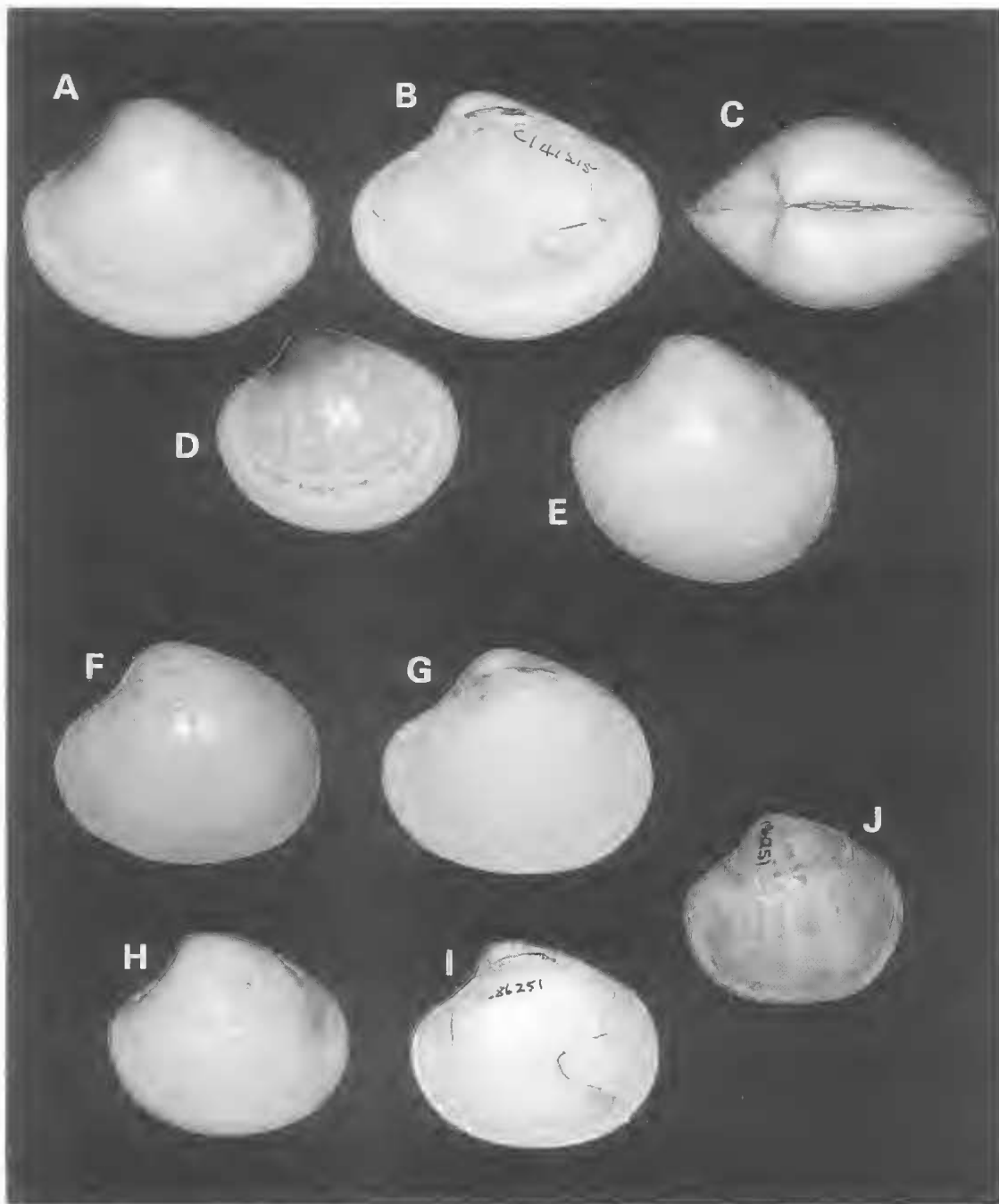


FIG. 4. A-E, *P. (Pitarina) pellucidus* (Lamarck). A-C, AMSC141215, Broome, WA, 34.4mm. A, external lv; B, internal rv; C, dorsal view of pv showing lunule and escutcheon. D, E, KL, Dingo Beach, central Qld. D, external lv, 33.7mm; E, external lv, 30.5mm. F-J, *P. (P.) potteri* Healy & Lamprell. F, G, holotype, QMMO32902, Palm Is, NEQ, 32.5mm; F, external lv; G, internal rv. H- J, AMSC086251, New Caledonia, 37.8mm. H, external lv; I, internal rv; J, external lv (length 34.5mm).

margin and subquadrate posterior. Specimens of *P. (P.) prora* have been examined from multiple lots which show obscure to strong tan radial patterns in some specimens while others have an all white surface. *Cytherea laeta* Lamarck, 1819 is lodged in the Museum de Genève (Collection Lamarck, No. 24, type lot 1084/27) and appears to be a synonym of this species, however the pallial sinus is deeper while another, smaller specimen from Lamarck's collection with the same registration number (1084/27) has a shallower pallial sinus similar to *P. (P.) prora*. Examination of the type of *Cytherea obliquata* Hanley, 1844: 355 (app) in the BMNH showed this to be conspecific with *P. (P.) prora*.

Pitar (Pitarina) pellucidus (Lamarck, 1818)
(Fig. 4A-E; 9B)

Cytherea pellucida Lamarck, 1818: 313; *Dione australica* Reeve, 1863: sp. 47, pl. 11; *Pitar (Pitarina) pellucidus* Lamprell & Whitehead, 1992: pl. 67, sp. 516; Lamprell & Staniscic, 1996: 42, fig. 4e-f.

DIAGNOSIS. Shell length to 45mm, thin, moderately inflated. Colour ranging from pure white to cream, usually with tan-coloured zigzag patterning, umbones often tinged light-brown with a purple spot beneath them.

MATERIAL EXAMINED. 1pv, BMNH1912.6.18.14, specimen figured by Sowerby (1853); 1pv, BMNH, holotype of *Cytherea australica* Reeve, 1863 from the Torres Strait. **OTHER MATERIAL:** 4rv, AMSC075783, Bathurst Head, Princess Charlotte Bay, NEQ, 14°16'S, 144°12'E; 1rv, AMSC142125, North Keppel I, Keppel Bay, central Qld, 23°04'S, 150°54'E, Aug 1946; 1pv, AMSC141215, Broome, WA, 17°58'S, 122°14'E; 2rv, 1lv, AMSC102766, Daintree River beach, NEQ, 16°17'S, 145°27'E, Nov 1928; 5pv, KL, trawled between Palfrey and Lizard Is, NEQ; 9pv, KL, Dingo Beach, central Qld, in littoral sand; 1pv, 1rv, KL, trawled to 10m, Little Trunk Reef, NEQ, Dec 1995; 5pv, KL, Suva, Fiji; 1pv, KL, Bundaberg, NEQ, littoral sand.

HABITAT AND DISTRIBUTION. Buried in shallow littoral sand; ranging from Japan, Philippines, New Caledonia, Solomon Islands, Fiji, Papua New Guinea, Australia from Queensland to northern Western Australia.

REMARKS. *P. (Pitarina) pellucidus* (Lamarck, 1818) is similar in shape to *P. (P.) subpellucidus* (Sowerby, 1851), *P. (P.) spoori* (Lamprell) & Whitehead, 1990 and *P. (P.) nancyae* but lacks the strong, broken radial rays of these species while the wide, shallow pallial sinus separates it from these and other Australian *Pitar* species.

Pitar (Pitarina) potteri Healy & Lamprell,
1992 (Fig. 4F-J; 9C)

Pitar (Pitarina) sp. Lamprell & Whitehead 1992: pl. 67, sp. 515 (as *Pitar* sp.); *Pitar (Pitarina) potteri* Healy & Lamprell, 1992: 79; fig. 1e-h; Lamprell & Staniscic, 1996: 45, fig. 6e,f.

DIAGNOSIS. Shell length to 38mm, solid, inflated. Sculpture of microscopic concentric growth striae. Colour cream-white with faint tan zigzag patterns near umbones; interior white.

MATERIAL EXAMINED. HOLOTYPE. 1pv, QMMO32902, Palm I, NEQ, 18°40'S, 146°35'E, trawled in 9-12m in sand and rubble, Nov 1990. **PARATYPES:** 1pv, AMC142109, Broadhurst Reef east of Townsville, NEQ, 18°57'S, 147°47'E, subtidal 27-28 Sept 1975; 1pv, AMSC105246, Watsons Bay, Lizard I, NEQ, 14°40'S, 145°27'E, 10.5m on sandy bottom, Dec 1975; 1pv, AMSC142108, Rudder Reef, NE Port Douglas, NEQ, 16°13'S, 145°40'E, intertidal, 1977; 1pv, AMSC08621, Lizard I, NEQ, 14°40'S 145°28'E; 2pv, WAM560-91, MVF60433, Palm I, NEQ, 18°40'S, 146°35'E, subtidal, Nov 1990. **OTHER MATERIAL.** 4pv, 1rv, KL, dredged Taylor Reef, NEQ, 10m, coral sand, 1995; 1pv, KL, dredged in lagoon, Slashers Reef No. 1, GBR, Nov 1993; 4pv, 2rv, AMSC086261, Noumea, New Caledonia, 22°18'S, 166°29'E, among corals and rocks; 1rv, AMSC103582, Palfrey I, Lizard I, 14°41'S, 145°27'E, NEQ, in shell sand, 3 Dec 1974; 2rv, 1lv, AMSC041511, Lizard I, GBR, 14°40'S, 145°28'E, 18 Jul 1916; 1lv, AMSC126664, Eagle I, beach W side, Lizard I, GBR, 14°42'S, 145°23'E, 12 Dec 1974.

HABITAT AND DISTRIBUTION. Reef areas, in shell sand and rubble to 12m; ranging from northern Queensland to New Caledonia.

REMARKS. *P. (Pitarina) potteri* Lamprell & Whitehead, 1992 is similar to *P. (P.) affinis* (Gmelin, 1791) but does not attain the size of that species, is more inflated in proportion and has a more rounded and ascending pallial sinus.

Pitar (Pitarina) trevori Lamprell &
Whitehead, 1990 (Fig. 5A-G; 9D)

Pitar (Pitarina) trevori Lamprell & Whitehead, 1990: 47, 4a-d; Lamprell & Whitehead, 1992: pl. 67, sp. 517.

DIAGNOSIS. Shell length to 30mm; moderately inflated; lunule incised. Sculpture of fine concentric striae, periodically crowded as growth pauses. Colour all white; periostracum, pale straw coloured, usually with sand adhering to the external surface.

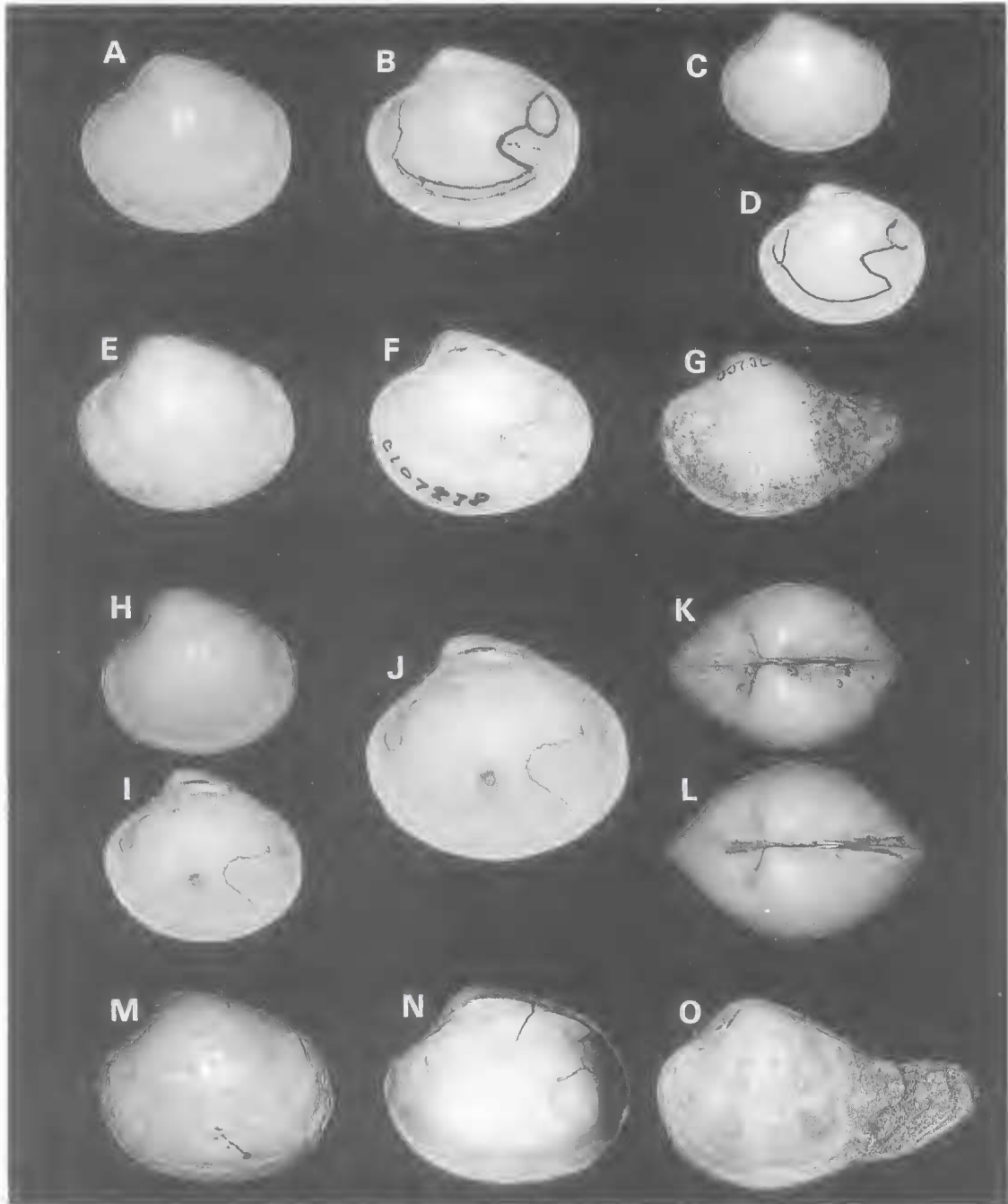


FIG. 5. A-G, *P. (Pitarina) trevori* Lamprell & Whitehead. A, B, holotype, QMMO22850, Dingo Beach, central Qld, 30mm. A, external lv; B, internal rv. C, D, KL, Turtle Is, Fiji, 30mm. C, external lv; D, internal rv. E, F, AMSC107878, Prince of Wales Is, north Qld, 29.3mm. E, external lv; F, internal rv. G, AMSC070200, Dingo Beach, central Qld, with siphon sheath attached, external pv, 31.3mm (including sheath). H-L, *P. (P.) queenslandica* sp. nov., holotype, AMSC306560, Black Is, NEQ, 21.1mm. H, external lv; I, internal rv; J., internal rv, enlargement; K, L, dorsal view of pv showing lunule and escutcheon. M-O, *P. (P.) subpellucidus* (Sowerby) KL, St Crispins Reef, NEQ, 33mm. M, external lv, N, internal rv; O, variation showing broad coloured rays, and with siphon sheath attached, external pv (length 43.9mm including sheath).

MATERIAL EXAMINED. HOLOTYPE: 1pv, QMM022850, on sand flats at low tide, Dingo Beach, central Qld, low tide, Jul 1987. PARATYPES, 1pv, MVF57679, same data as holotype; 1pv, AMSC160471, same data as holotype; 1pv, WAM939-89, on sand flats at low tide, Gove, NT, KL, Aug 1987. OTHER MATERIAL: 1pv, AMSC41611, Annan River near Cooktown, NEQ, Aug 1916; 1pv, 3rv, 1lv, AMSC107878, N of Terry Beach, W side of Prince of Wales I, Torres Strait, 10°42'S, 142°7'E, Jun-Jul 1976; 3rv, 2lv, AMSC306542, Lindeman I, central Qld, 20°27'S, 149°02'E, Nov 1934; 3rv, 2lv, AMSC306537, between Lindeman and Shaw Is, Kennedy Sound, central Qld, 20°25'S, 149°01'E; 2pv, AMSC070200, Cape Gloucester, Dingo Beach, 20°05'S, 148°30'E, central Qld; 4pv, KL, Kurrimine Beach, NEQ; 1pv, AMSC141215, Broome, northern WA, 17°58'S, 122°14'E; 2pv, KL, Turtle I, Fiji.

HABITAT AND DISTRIBUTION. Buried in shallow littoral sand; ranging in Australia from central Queensland to the Northern Territory, northern Western Australia to Fiji.

REMARKS. *Pitar (Pitarina) trevori* Lamprell & Whitehead, 1990 occurs sympatrically with *P. (P.) pellucidus* (Lamarck, 1818) but that species differs in being more inflated, having an incised lunule and completely lacking the umbonal colouring and umbonal spot of that species.

***Pitar (Pitarina) queenslandica* sp. nov.**
(Fig. 5H-L; 9E)

ETYMOLOGY. For Queensland.

DESCRIPTION. Shell length to 22.3mm, sub-trigonal, equivalve, inequilateral (the umbones situated forward of centre), thin; umbones pro-sogyrate; lunule well developed, heart-shaped, striate, raised centrally, defined by a faint impressed line; anterodorsal margin short, almost straight, steeply sloping, convex terminally; posterodorsal margin, long, slightly convex, steeply sloping, convex to slightly truncate posteriorly; ventral margin evenly convex. Shell sculpture of well defined concentric striae, obsolete umbonally, stronger marginally. Periostracum, thick, grey with agglutinated sand adhering to the shell margins. Ligament, impressed. Hinge of lv with anterior lateral tooth well developed, peg-like; anterior cardinal thin, joined to thick median cardinal forming an inverted v-shape; posterior cardinal long, thin, ridge-like, free. Hinge of rv with hinge line expanded ventrally at pit for the reception of the lv lateral tooth; anterior cardinal, narrow; median cardinal free, slightly oblique; posterior cardinal bifid, oblique. Muscle

attachment scars well defined; anterior adductor scar teardrop-shaped, posterior adductor scar larger and more rounded. Pallial sinus extends medially, one third of the shell length, moderately wide, rounded terminally. Shell colour internally and externally glossy white.

MATERIAL EXAMINED. HOLOTYPE: 1pv, AMSC306560, Black I, Langford Reef, central Qld, 20°05'S, 148°54'E, dredged, 18m, Nov 1969. Length of shell 21.1mm, height 18.4mm, width 13.65mm. PARATYPES, 4pv, 2lv, 1rv, AMSC96704, dredged off Lindeman I, central Qld, 1935; 2lv, 6rv, AMSC306534, SE of Sarina, central Qld, 21°47'S, 150°34'E, dredged 59m, Dec 1977; AMSC58758 (pt), dredged off Lindeman I, central Qld, Aug 1935; 1pv, QMM059380, Gulf of Carpentaria, 12°22'S, 141°35.2'E, 13m. OTHER MATERIAL: 1rv, AMSC306556, off Caloundra, southern Qld, 26°47'S, 153°35'E, 128m, Mar 1969; 3lv, 2rv, AMSC58758 (pt), off Lindeman I, central Qld, Aug 1935; AMSC306533, E of Sarina, central Qld, 21°28'S, 150°08.5'E, sandy mud, Nov 1977; 1lv, AMSC306557, Caloundra, southern Qld, 26°49'S, 153°9'E, beach, Oct 1963; 2lv, 4rv, AMSC306562, Caloundra, southern Qld, 26°49'S, 153°10'E, beach; 9lv, 6rv, AMSC306540, E of Broad Sound, southern Qld, 21°58.5'S, 150°45'E, 57m, in coarse to fine sand and mud, Nov 1977; many juveniles. AMSC029671, Cairns Reef, NEQ, 15°42'S, 142°30'E, 9-18m, Aug 1906; 2rv, 1lv, AMSC306559, off Cairns, NEQ, 16°51.6S, 146°1.2'E, 33-35m, sandy-mud and shell, Oct 1981; 2lv, 1rv, AMSC306532, E of Mackay, central Qld, 20°52'S, 149°29'E, 35m 1977; 1pv, AMSC093523, Point Cartwright, southern Qld, 26°41'S, 153°08'E, 1963; 4pv, 1pv, KL, Llewellyn Bay, Armstrong Beach, Sarina, central Qld, after storm, Apr 1995; KL, Gulf of Carpentaria, NEQ, 11°10.2'S, 139°03.2'E, 52.5m.

HABITAT AND DISTRIBUTION. Dredged in silty sand to 128m; appears to be restricted to Queensland.

REMARKS. *P. (Pitarina) queenslandica* sp. nov. is a small species, the largest specimen sighted, AMSC306556 is 22.3mm. It is most like *P. (P.) trevori* Healy & Lamprell, 1992 which is also glossy white with a sub-trigonal shell. However *P. (P.) queenslandica* is readily separated by its much smaller size, ventrally expanded hinge line (straight in *P. (P.) trevori*) and much deeper pallial sinus. Compared with *P. (P.) pellucidus* (Lamarck, 1818), *P. (P.) subpellucidus* (Sowerby, 1851), *P. (P.) lineolatus* (Sowerby, 1854) and *P. (Hyphantosoma) limatula* (Sowerby, 1853), *P. (P.) queenslandica* does not attain the size of these species, has a more extended pallial sinus and does not exhibit a colour pattern (uniformly

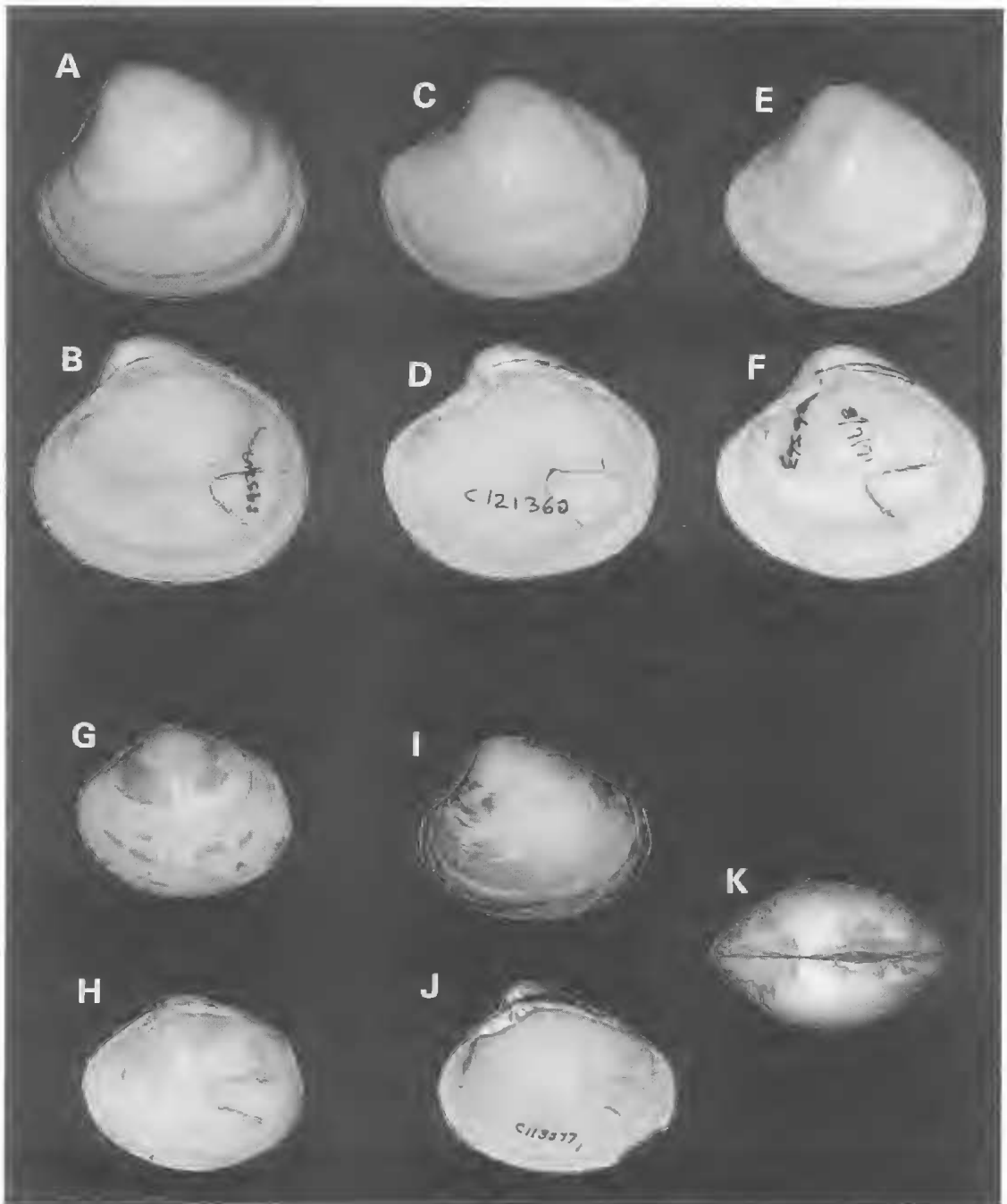


FIG. 6. A, B, *P. (Pitarina) japonicus* Kuroda & Kawamoto, AMSC095267, south of Yeppoon, Qld, 37.6mm. A, external lv; B, internal rv. C, D, *P. (P.) noguchii* Habe, AMSC121360, Roebuck Bay, Broome, northern WA, 37.3mm. C, external lv; D, internal rv. E, F, *P. (P.) nipponica* Kuroda & Habe, AMSC306563, Shelley Beach, Townsville, north Qld, 27.3mm. E, external lv; F, internal rv. G, H, *P. (P.) sophiae* (Angas), KL, off Caloundra, Qld, 28.9mm. G, external lv; H, internal rv. I-K, *P. (P.) thornleyae* sp. nov., holotype, AMSC113277, Karumba, Gulf of Carpentaria, north Qld, 46.8mm. I, external lv; J, internal rv (broken ventro-posterior margin); K, dorsal view pv showing lunule and esutcheon.

glossy white in *P. (P.) queenslandica*). Compared with *P. (P.) coxeni* (Smith, 1885) and *P. (P.) sophiae* (Angas, 1877) which are also small in size and approximately similar in shape, *P. (P.) queenslandica* does not have the colour pattern usually evident in *P. (P.) sophiae* while the pallial sinus is deeper in *P. (P.) queenslandica* than in both *P. (P.) sophiae* and *P. (P.) coxeni* (sinus angulate in *P. (P.) coxeni*).

Pitar (Pitarina) subpellucidus
(Sowerby, 1851) (Fig. 5M-O; 9F)

Cytherea subpellucidus Sowerby, 1851: 639. pl. 133, f. 136; *Dione tarresica* Reeve, 1863: pl. 11, sp. 51; *Pitar (Pitarina) subpellucidus* (Sowerby) Habe, 1977: 257; Lamprell & Whitehead, 1992: pl. 67, sp. 517.

DIAGNOSIS. Shell length to 40mm, elongate ovate, moderately inflated. Sculpture of fine concentric striae. Colour cream with dense brown radial rays, purple posteriorly; umbones brown with purple spots beneath; interior tinged purple posteriorly.

MATERIAL EXAMINED. KL, 1pv, Barber I, NE Palm I, NEQ; KL, 1pv, St Crispins Reef, NEQ; KL, 1pv, Low I, NEQ; KL, 1pv, Cobham Reef, near Gould Reef, central Qld; KL, 1pv, Palm I, NEQ, dredged to 10m; KL, 4pv, Lizard I, between Palfrey and Eagle I, NEQ, 29m.

HABITAT AND DISTRIBUTION. Dredged to 10m in coral and littoral sand, coastal and GBR; ranging from Japan to Queensland, Australia.

REMARKS. This is not a common species but appears to be widely distributed, further collecting should increase the known range of the species. *P. (P.) subpellucidus* (Sowerby, 1851) is similar in shape to *P. (P.) pellucidus* (Lamarck, 1818) but is readily distinguished by its more highly coloured shell.

Pitar (Pitarina) japonicus Kuroda & Kawamoto, 1956 (Fig. 6A,B; 9G)

Pitar (Agriopoma) japonicum Kuroda & Kawamoto, 1956: 89, figs 1-4; *Pitar (Pitarina) japonicum* Habe, 1977: 257; Lamprell & Whitehead 1992: pl. 67, sp. 522; Lamprell & Staniscic, 1996: 44, fig. 5g,h.

DIAGNOSIS. Shell length to 35mm; thin, ovate-triangular, umbones prosogyrous. Sculpture of fine concentric growth lines. Colour cream-white, with pale orange or pink umbones and interior,

MATERIAL EXAMINED. 2pv, AMSC106921, South Great Keppel I, central Qld, 23°12'S, 150°58'E; 2rv, 2lv, AMSC093524, Keppel Bay, central Qld, 23°25'S, 150°55'E; 1pv, AMSC095267, Zilzie Point, central Qld, 23°17'S, 150°50'E, sheltered mud flats; 1pv, KL, Lammermoor Beach, central Qld, after storm; 1pv, KL, Boyne Is Beach, central Qld, low tide; 1pv, KL, Dingo Beach, central Qld, low tide; 1rv, AMSC142126, Penguin Channel, GBR, 16°15'S, 145°31'E, 18-28.5m; 1pv, 1rv, KL, Shelburne Bay, NEQ, 12°41'3"S, 140°42.5'E, Jan 1993; 1pv, AMSC092622, Groote Eylandt, Gulf of Carpentaria, 14°00'S, 136°25'E, Oct 1973; 1rv, AMSC306565, 32km off Point Charles, Darwin, NT, 12°10'S, 130°22'E, 237m, Jul 1938.

HABITAT AND DISTRIBUTION. Buried in tidal sand and mud; ranging from Japan, New Caledonia, central Queensland to northern Australia.

REMARKS. *P. (Pitarina) japonicus* Kuroda & Kawamoto, 1956 is reasonably common throughout its range. Recent records from New Caledonia mark the southern limit of its distribution.

Pitar (Pitarina) noguchii
Habe, 1958 (Fig. 6C,D; 9H)

Pitar (Agriopoma) noguchii Habe, 1958: 34; *Pitar (Pitarina) noguchii* Habe, 1964: pl. 58, fig. 6; Habe, 1977: 257; Lamprell & Staniscic, 1996: 42, fig. 4g-h.

DIAGNOSIS. Shell length to 37.3mm, thin, inflated. Sculpture of fine concentric ridges and irregular blue growth pauses, with small puncture marks over surface. Colour white internally and externally.

MATERIAL EXAMINED. 1pv, AMSC121360, Roebuck Bay, Broome, northern WA, 18°00'S, 122°15'E; 1pv, AMSC13871, North Keppel Island, Keppel Bay, central Qld, 23°04'S, 150°54'S, 1970; 1pv, AMSC308648, Philippines, purchased from Sowerby and Fulton, presented by C. Hedley.

HABITAT AND DISTRIBUTION. Dredged in sand to 150m; ranging from Japan to New Caledonia and Australia from Queensland to north Western Australia.

REMARKS. Hitherto only recorded from Japan, recent collecting has extended the known distribution to New Caledonia (Lamprell & Staniscic, 1996). These appear to be the first records of the species from Australia which is a significant range extension.

Pitar (Pitarina) nipponica Kuroda & Habe,
1971 (Fig. 6 E,F; 9I)

Pitar (Pitarina) nipponica Kuroda & Habe, 1971;
Habe, 1977: 257; Lamprell & Whitehead, 1992: pl.
67, sp. 531.

DIAGNOSIS. Shell length to 23mm; subtrigonal. Sculpture of fine concentric growth striae; surface covered with small, random puncture marks. Colour white, externally; interior white, yellow centrally.

MATERIAL EXAMINED. HOLOTYPE: 1pv, NSMT, MOR9601, Amadai-ba [bank], or off Hayama, Sagami Bay, [Kanagawa, Japan] 1971. OTHER MATERIAL: 3lv, AMSC093520, South West Rocks, Trial Bay, central NSW, 30°53'S, 153°04'E, beach, Aug 1960; 1pv, AMSC306545, off Tweed Heads, north-eastern NSW, 28°08'-28°12'S, 153°40'-153°45'E, 54m, Oct 1936; 4rv, 2lv, AMSC054657, Caloundra beach, southeastern Qld, 26°49'S, 153°10'E, May 1926; 1pv, KL, Pallarenda Beach, Townsville, NEQ, low tide; 3pv, KL, AMSC306563, AMSC142127, Shelley Beach, Townsville, NEQ, 19°11'S, 146°45'E, low tide, Aug 1970; 1pv, KL, Exmouth Gulf, WA; 1pv, KL, Arafura Sea, Bureau of Rural Resources, 1990.

HABITAT AND DISTRIBUTION. Buried in littoral sand and to 54m; ranging from Japan to Queensland and north Western Australia.

REMARKS. *P. (Pitarina) nipponica* Kuroda & Habe, 1971 is similar to *P. (P.) japonicum* Kuroda & Kawamoto, 1956 but is smaller, has more lightly coloured umbones and random puncture marks on the external surface.

Pitar (Pitarina) sophiae (Angas, 1877)
(Fig. 6G-H; 10A)

Cytherea sophiae Angas, 1877: 176, pl. 26, f. 23; *Pitar (Pitarina) sophiae* (Angas) Lamprell & Whitehead, 1992: pl. 68, sp. 531; Lamprell & Stanisic, 1996: 45, fig. 6c-d.

DIAGNOSIS. Shell length to 17mm, thin, inflated. Sculpture of concentric growth striae, surface smooth, glossy. Colour white, with grey concentric bands, sometimes with faint brown broken rays; umbones usually tinged with red anteriorly, visible internally.

MATERIAL EXAMINED. 2rv, AMSC306495, Manly Beach, Sydney, NSW, 33°48'S, 151°17'E; 1pv, AMSC306544, ENE of Point Danger, northern NSW, 27°04'-27°59'S, 153°50'E, 137-146m; 1pv, AMSC007545, inner North Head, Port Jackson, Sydney, NSW, 33°49'S, 151°17'E, 15m, in sand; 1rv,

AMSC306571, Christmas I, off NE point, 10°25'S, 105°42'E, 183m.

HABITAT AND DISTRIBUTION. Dredged to 183m in sand; ranging from New South Wales, central to northern Queensland, Australia, Christmas I, to New Caledonia.

REMARKS. Smith (1885) considered *P. (Pitarina) sophiae* (Angas, 1877) to be a synonym of *Cytherea hebraea* Lamarck, 1818. However comparison of specimens of *P. (P.) sophiae* in the Australian Museum and the holotype of *P. (P.) hebraea* in the Museum de Geneve shows that *P. (P.) sophiae* is longer in proportion to height than *P. (P.) hebraea*, is more widely rounded at the anterior and posterior margins, does not attain the size of that species and has a pink flush on the inner side of the valves of many specimens. Additionally, the pallial sinus in *P. (P.) hebraea* is wider, deeper and less ascending than in *P. (P.) sophiae*.

Pitar (Pitarina) thornleyae sp. nov.
(Fig. 6I-K; 10B)

ETYMOLOGY. For Ms Gertie Thornley.

DIAGNOSIS. Shell length to 46.8mm, elongate-ovate, equivalve, inequilateral, the anterior end of shell being 1/3 of the shell length; moderately inflated, thin; umbones approximate, lunule narrowly heart-shaped, striated, surrounded by an impressed line; anterodorsal margin moderately convex, sharply sloping, narrowly rounded terminally; posterodorsal margin almost straight, gently sloping, posterior margin narrowly rounded; ventral margin convex. Sculpture of coarse, irregular concentric ridges and growth pauses; periostracum grey, with sand adhering to most of shell surface. Ligament, narrow, partially external. Hinge of lv with anterior lateral tooth narrow, peg-like, moderately thick; anterior cardinal, slightly oblique; median cardinal solid, broad, raised; posterior cardinal long, oblique; posterior lateral, long, thin, parallel to the nymph. Hinge of rv with paired anterior laterals, separated by a deep pit; anterior cardinal thin, raised; median cardinal thin, not joined, parallel to anterior cardinal, separated by a narrow pit; posterior cardinal oblique and bifid; posterior lateral long, solid, parallel to the nymph. Muscle adductor scars well defined, anterior adductor scar elongate-ovate, posterior adductor scar teardrop-shaped. Pallial line ragged. Pallial sinus extending one-third medially, triangular. Colouration off-white externally, internally white.

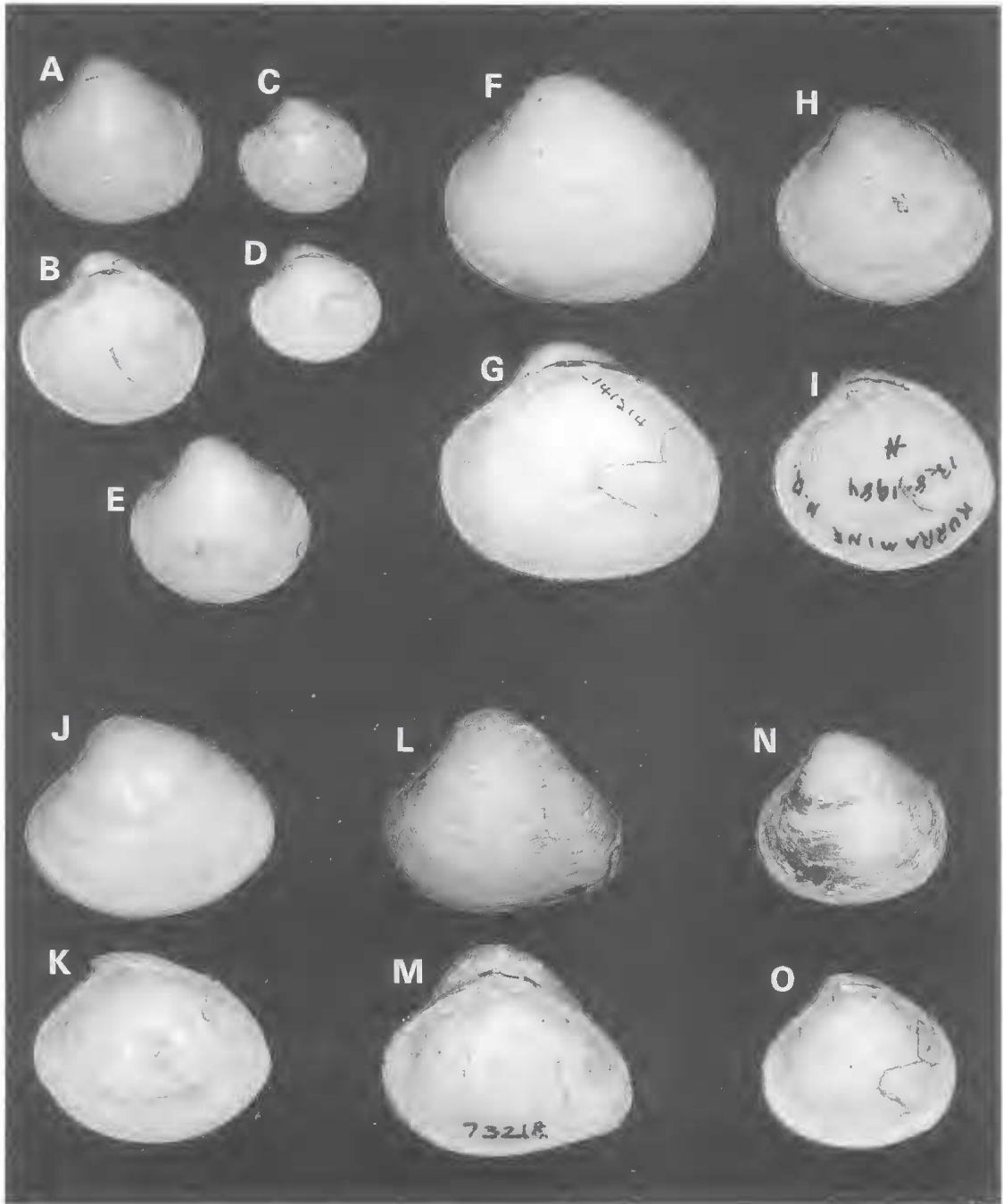


FIG. 7. A-E, *P. (Pitarina) lineolatus* (Sowerby). A, B, KL, Torres Strait, 24mm. A, external lv; B, internal rv. C, D, KL, Palm Is, NEQ, juvenile, 17mm. C, external lv; D, internal rv. E, KL, Torres Strait, external lv, 24mm. F, G, *P. (P.) bullatus* (Sowerby), AMSC141214, Broome, northern WA, 36.2mm. F, external lv; G, internal rv. H, I, *P. (P.) sulfureum* Pilsbry, KL, Kurrimine Beach, NEQ, 28.9mm. H, external lv; I, internal rv. J, K, *P. (P.) coxeni* (Smith), KL, Shelburne Bay, NEQ, 13.5mm. J, external lv; K, internal rv. L, M, *P. (P.) inconstans* (Hedley), AMSC073218, Madang, PNG, 22.1mm. L, external lv; M, internal rv. N, O, *P. (P.) regularis* (Smith), AMSC306561, Magnetic Is, NEQ, 15.5mm. N, external lv; O, internal rv.

MATERIAL EXAMINED, HOLOTYPE: 1pv, AMSC113277, off Karumba, SE Gulf of Carpentaria, northern Qld, 17°30'S, 140°00'-141°00'E, 1963-4. Length of shell 46.8mm, height 36.4mm, width of conjoined valves 26.8mm. **PARATYPE:** 2rv, 1lv, AMSC308642, Gulf of Carpentaria, northern Qld, 1980; 1rv, AMSC74865, Gulf of Papua, PNG, Feb 1969; 1pv, AMSC14952, Karumba, northern Qld, 17°29'S, 140°50'E, beach, Jun 1903; 2pv, AMSC107015, AMSC107028, off Albert River, Gulf of Carpentaria, northern Qld, 17°24'S, 139°47'E, Dec 1963; 1pv, AMSC107296, W of Topsy Creek, E Gulf of Carpentaria, northern Qld, 15°28'S, 141°28.7'E, Dec 1876; 1pv, AMSC115732, 7km from Norman River mouth, Karumba, northern Qld, 17°29'S, 140°50'E, washed from river bank; AMSC117072, off Karumba, SE Gulf of Carpentaria, northern Qld, 17°30'S, 140°00'-141°00'E.

HABITAT AND DISTRIBUTION. Buried in sandy mud near mouths of rivers; ranging from northern Queensland to Papua New Guinea.

REMARKS. *Pitar (Pitarina) thornleyae* sp. nov is most similar to *P. (P.) trevori* Healy & Lamprell, 1990, *P. (P.) pellucidus* (Lamarck, 1818) and *P. (P.) subpellucidus* (Sowerby, 1851) in being elongate-ovate and moderately inflated but is readily separated by its larger size, much stronger concentric ridges, longer posterodorsal margin, triangular shaped pallial sinus (wide and short in *P. (P.) pellucidus* and *P. (P.) subpellucidus*, short and ascending in *P. (P.) trevori*). There are no other known Australian *Pitar* species which have the strong concentric ridges of *P. (P.) thornleyae*.

***Pitar (Pitarina) lineolatus* (Sowerby, 1854)**
(Fig. 7A-E; 10C)

Cytherea lineolatus Sowerby, 1854: pl. 168, figs 214-5; *Pitar (Pitarina) lineolatus* Habe, 1977: 257; Lamprell & Whitehead 1992: pl. 67, sp. 524.

DIAGNOSIS. Shell length to 24mm, ovate. Sculpture of fine concentric striae. Colour cream usually with zigzag markings on the escutcheon, lunule, and sometimes faintly on the rest of the shell.

MATERIAL EXAMINED. 1pv, KL, Torres Strait, northern Qld, dredged to 15m; 2pv, KL, Palm I, NEQ, dredged in Curacao Channel to 15m; 1lv, KL, Little Trunk Reef, NEQ, dredged to 10m, Dec 1995.

HABITAT AND DISTRIBUTION. Dredged in sand to 16m; ranging from Japan, to northern Queensland and the Torres Strait, Australia.

REMARKS. *Pitar (Pitarina) lineolatus* (Sowerby, 1854) is similar to *P. (P.) limatula* (Sowerby, 1853) but readily separated by the cream-white colour and tan zigzag pattern on the lunule and dorsal margin (yellow coloured with black staining on lunule and escutcheon on *P. (H.) limatula*).

***Pitar (Pitarina) bullatus* (Sowerby, 1851)**
(Fig. 7F,G; 10D)

Cytherea bullata Sowerby, 1851: p.640, sp.96, pl. 136, fig. 192; Lamprell & Whitehead 1992: pl. 67, sp. 531.

DIAGNOSIS. Shell length to 36.2mm, solid, broadly subtrigonal, inflated, with large inflated umbones. Sculpture of fine concentric striae and growth lines. Colour chalky white externally; interior white.

MATERIAL EXAMINED. 17pv, KL, Turkey Beach, central Qld, on sand/mud flats low tide; 1pv, KL, Dingo Beach, central Qld, sand flats low tide; 1pv, KL, Gladstone, southern Qld, on sand flats, Jan 1976, 1pv, KL, Dampier, northern WA, 1987; 1pv, AMSC141214, Broome, northern WA, 17°58'S, 122°14'E; 4pv, AMSC051544, AMSC093530, Roebuck Bay, Broome, northern WA, 18°00'S, 122°15'E; 1pv, KL, Black Ledge, Broome, northern WA, on mud/sand flats, 1994; 4pv, KL, Broome, northern WA, on sand/mud flats.

HABITAT AND DISTRIBUTION. Buried in shallow littoral sand/mud flats; ranging in Australia from Queensland, Northern Territory to northern Western Australia.

REMARKS. *Pitar (Pitarina) bullatus* (Sowerby, 1851) can be readily separated from other Australian *Pitar* species by its solid, chalky, elongate-ovate shell and straight ventral margin.

***Pitar (Pitarina) sulfureum* Pilsbry, 1904**
(Fig. 7H,I; 10E)

Pitar (Pitarina) sulfureum Pilsbry, 1904: 553, pl. 39; Lamprell & Whitehead 1992: pl. 68, sp. 532.

DIAGNOSIS. Shell to length 30mm, light, inflated; almost chalky; escutcheon ill-defined but protrusive. Sculpture smooth, indistinct, fine striae. Colour yellow-cream; umbones yellow, sometimes tinged pink; interior cream-white, light-yellow centrally.

MATERIAL EXAMINED. 2lv, AMSC306570, SW of Losuia, Kiriwinna I, Trobriand Group, PNG, 8°33'S, 151°04'E, on sand flats, Jun 1970; 2pv, AMSC306552, SE of Exmouth Homestead, Exmouth Gulf, northern

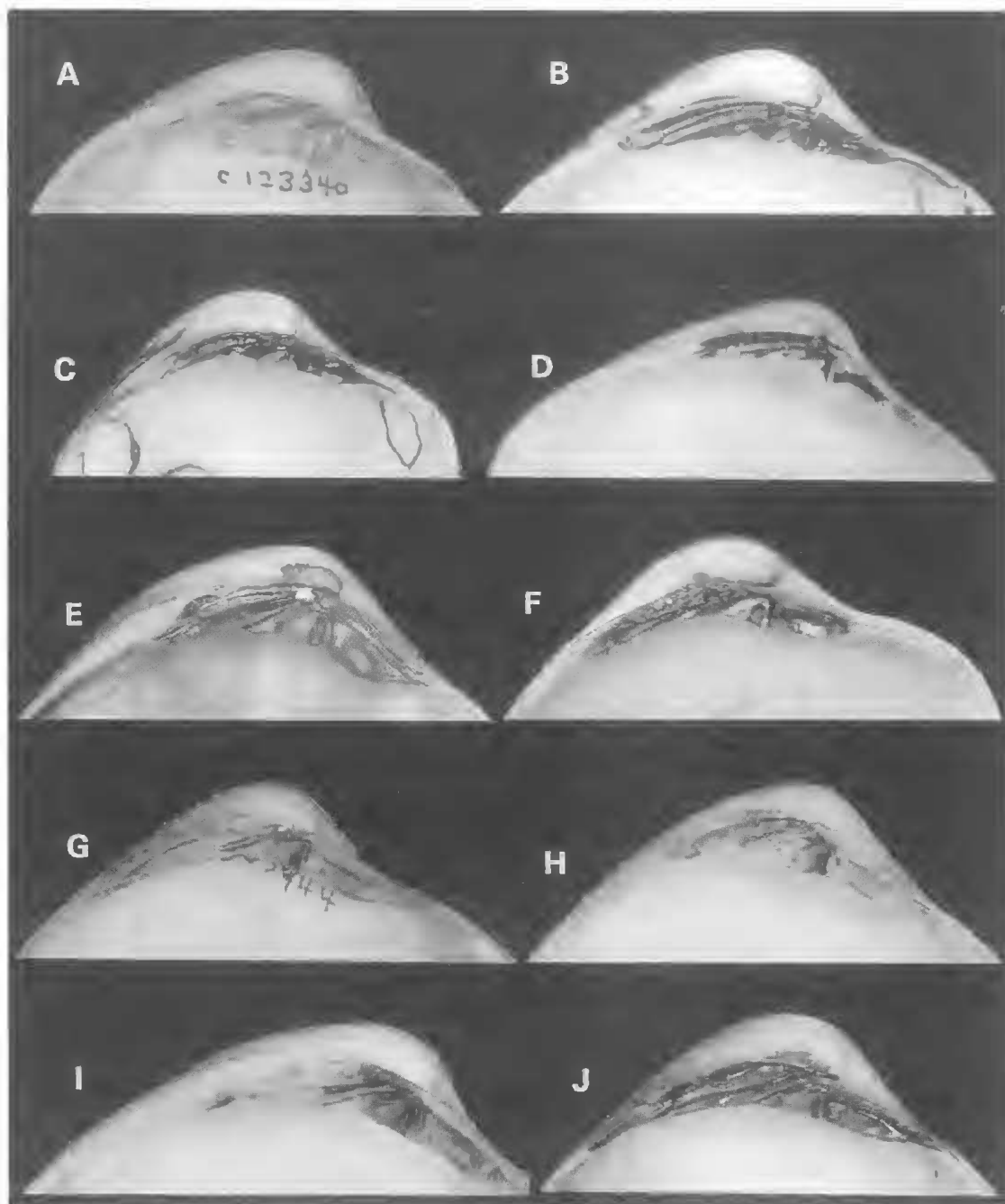


FIG. 8. Comparative hinge plate and teeth of rv. A, *P. (Hyphantosoma) intricata* (Dautzenberg), AMSC123340, 52.5mm; B, *P. (H.) spoori* Lamprell & Whitehead, holotype, AMSC133572, Bank Reef NEQ, 31mm; C, *P. (H.) limatula* (Sowerby), KL, Dingo Beach, central Qld, 24.2mm; D, *P. (H.) caperi* sp. nov., holotype, AMSC202973, Upolu Cay, NEQ, 22.8mm; E, *P. (P.) citrina* (Lamarck), KL, Shark Bay, northern WA, 45.4mm; F, *P. (H.) nancyae* Lamprell & Whitehead, off Caloundra, Qld, 28.6mm; G, *P. (P.) osmunda* (Iredale) AMSC303944, Sydney Harbour, 36.5mm; H, *P. (P.) curnowae* sp. nov., holotype, AMSC202974, Madang, PNG, 42.6mm; I, *P. (P.) prora* (Conrad) KL, North West Is, Qld, 63mm; J, *P. (P.) marrowae* Healy & Lamprell, QMMO32900, Dingo Beach, central Qld, 38.1mm.

WA, 22°24'S, 114°08'E, on muddy sand flats; 2pv, KL, Kurrimine Beach, NEQ, low tide on sand.

HABITAT AND DISTRIBUTION. Buried in loose shallow muddy sand flats; ranging from Japan to Papua New Guinea and Queensland.

REMARKS. *Pitar (Pitarina) sulfureum* Pilsbry, 1904 is recognised by its rough surface and dense, fine concentric striae and chalky yellow-cream appearance. In these respects it is most similar to *P. (P.) bullatus* (Sowerby, 1851) but differs by having a convex ventral margin (almost straight in *P. (P.) bullatus*). *P. (P.) bullatus* also has a rough surface and dense, fine concentric striae and chalky white appearance. However *P. (P.) sulfureum* differs from *P. (P.) bullatus* by having a convex ventral margin (almost straight in *P. (P.) bullatus*). *P. (P.) sulfureum* appears to be a rare species in Australia with few specimens either in the Museum or private collections.

***Pitar (Pitarina) coxeni* (Smith, 1885)**
(Fig. 7J,K; 10F)

Cytherea (Caryatis) coxeni Smith, 1885: 139, pl. 1, figs 7-7e; *Pitar (Pitarina) coxeni* Lamprell & Whitehead, 1992: pl. 68, sp. 530.

DIAGNOSIS. Shell length to 13mm, thin, ovate, moderately obese. Sculpture of fine, close, distinct concentric striae, often polished. Colour white, internally and externally; obscure brown or red lines and dots or pale growth lines sometimes occur.

MATERIAL EXAMINED. 1pv, KL, Whitsunday Passage, central Qld, trawled to 10m; 2pv, KL, Shelburne Bay, NEQ, 12°39.4'S, 141°09'E, 41m, Jan 1993.

HABITAT AND DISTRIBUTION. Dredged in sand to 25m; ranging from central Queensland to the Northern Territory and Papua New Guinea.

REMARKS. *Pitar (Pitarina) coxeni* (Smith, 1885) is very fragile and rare even in Museum collections. *P. (P.) coxeni* is most similar to *P. (P.) sophiae* (Angas, 1877) in size, shape and fragility, but differs in having a more attenuate posterior margin and angulate pallial sinus (posterior margin widely convex and pallial sinus widely rounded in *P. (P.) sophiae*).

***Pitar (Pitarina) inconstans* (Hedley, 1923)**
(Fig. 7L,M; 10H)

Pitar (Pitarina) inconstans Hedley, 1923: 304; Lamprell & Whitehead, 1992: pl. 68, sp. 529.

DIAGNOSIS. Shell length to 20mm, inflated, subtrigonal, posteriorly attenuate. Sculpture fine, almost polished, concentric growth lines. Colour white, sometimes with grey growth bands; interior white.

MATERIAL EXAMINED. 1pv, AMSC073218, Madang, PNG, 5°02.5'S, 145°7'E; 3pv, KL, Buffalo Creek, Darwin, NT, 1984; many, KL, Nanum Beach, Weipa, NEQ, Jul 1992, N. Trevor; 3pv, KL, Numbulwar, Gulf of Carpentaria, NT, 1984.

HABITAT AND DISTRIBUTION. In shallow littoral sand; ranging in Australia from north Queensland and the Northern Territory to Papua New Guinea and Malaysia.

REMARKS. *Pitar (Pitarina) inconstans* (Hedley, 1923) is quite variable in shape and remarkably similar to the mactrid *Notospisula trigonella* (Lamarck, 1819) which is equally variable in shape but is readily separated from that species by the hinge teeth.

***Pitar (Pitarina) regularis* (Smith, 1885)**
(Fig. 7N,O; 10G)

Cytherea (Caryatis) regularis Smith, 1885: 140, pl. 1, figs 8-8b; *Pitar (Pitarina) regularis* Lamprell & Whitehead, 1992: pl. 68, sp. 528.

DIAGNOSIS. Shell length to 19mm, compressed. Sculpture of close-set concentric ridges, slightly lamellate posteriorly. Colour off-white with rust-brown concentric bands.

MATERIAL EXAMINED. 1pv, AMSC306561, Horseshoe Bay, Townsville, NEQ, 19°06.8'S, 146°51.8'E, Sep 1980; 2pv, 2lv, 2rv, AMSC306535, off Broad Sound, central Qld, 22°06'S, 150°49'E, 53m, among coarse shell, Dec 1977; lv, AMSC306531, off Cairns, NEQ, 16°55'S, 146°07'E, 37-40m, sandy shell and mud; 2pv (juvenile), AMSC306530, Arafura Sea, NE of Croker I, NT, 10°36'S, 132°56.5'E, 62m; 1pv, KL, Boyne I, Qld, beach; 1pv, KL, Gulf of Carpentaria, NT, Bureau of Rural Resources, 1990.

HABITAT AND DISTRIBUTION. In littoral sand and dredged in sandy mud and coarse shell to 62m; ranging from Hong Kong, West Malaysia to Australia, north Queensland, Torres Strait, Northern Territory and north Western Australia.

REMARKS. *Pitar (Pitarina) regularis* (Smith, 1885) is most similar to *P. (P.) bullatus* (Sowerby, 1851) in being solid, having a rough, chalky surface, fine concentric growth lines and white colour. *P. (P.) regularis* differs in the ventral margin being convex (straight in *P. (P.) bullatus*),

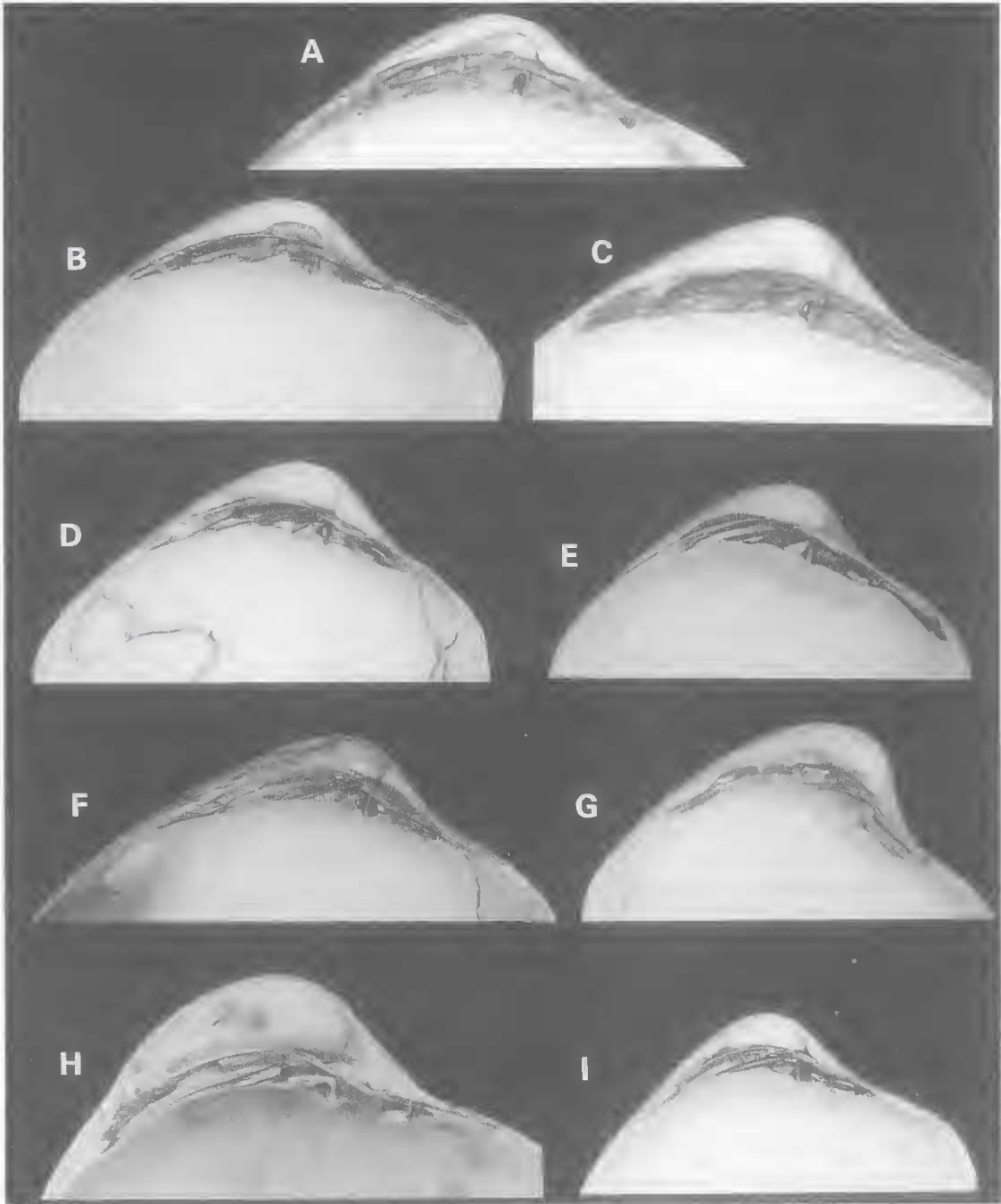


FIG. 9. Comparative hinge plate and teeth of rv. A, *P. (Pitarina) affinis* (Gmelin) KL, Shark Bay, northern WA, 55.8mm; B, *P. (P.) pellucidus* (Lamarck) KL, Dingo Beach, central Qld, 34.4mm; C, *P. (P.) potteri* Healy & Lamprell, holotype, QMMO32902, Shelly Beach, NEQ, 38mm; D, *P. (P.) trevori* Lamprell & Whitehead, holotype, QMMO22850, Dingo Beach, central Qld, 30mm; E, *P. (P.) queenslandica* sp. nov., holotype, AMSC306560, Black Is, NEQ, 21mm; F, *P. (P.) subpellucidus* (Sowerby) KL, St Crispins Reef, NEQ, 33mm; G, *P. (P.) japonicus* Kuroda & Kawamoto, AMSC095267, south of Yeppoon, Qld, 37.6mm; H, *P. (P.) noguchii* Habe, AMSC121360, Roebuck Bay, Broome, WA; I, *P. (P.) nipponica* Kuroda & Habe, AMSC306563, Shelley Beach, Townsville, NEQ, 27.3mm.

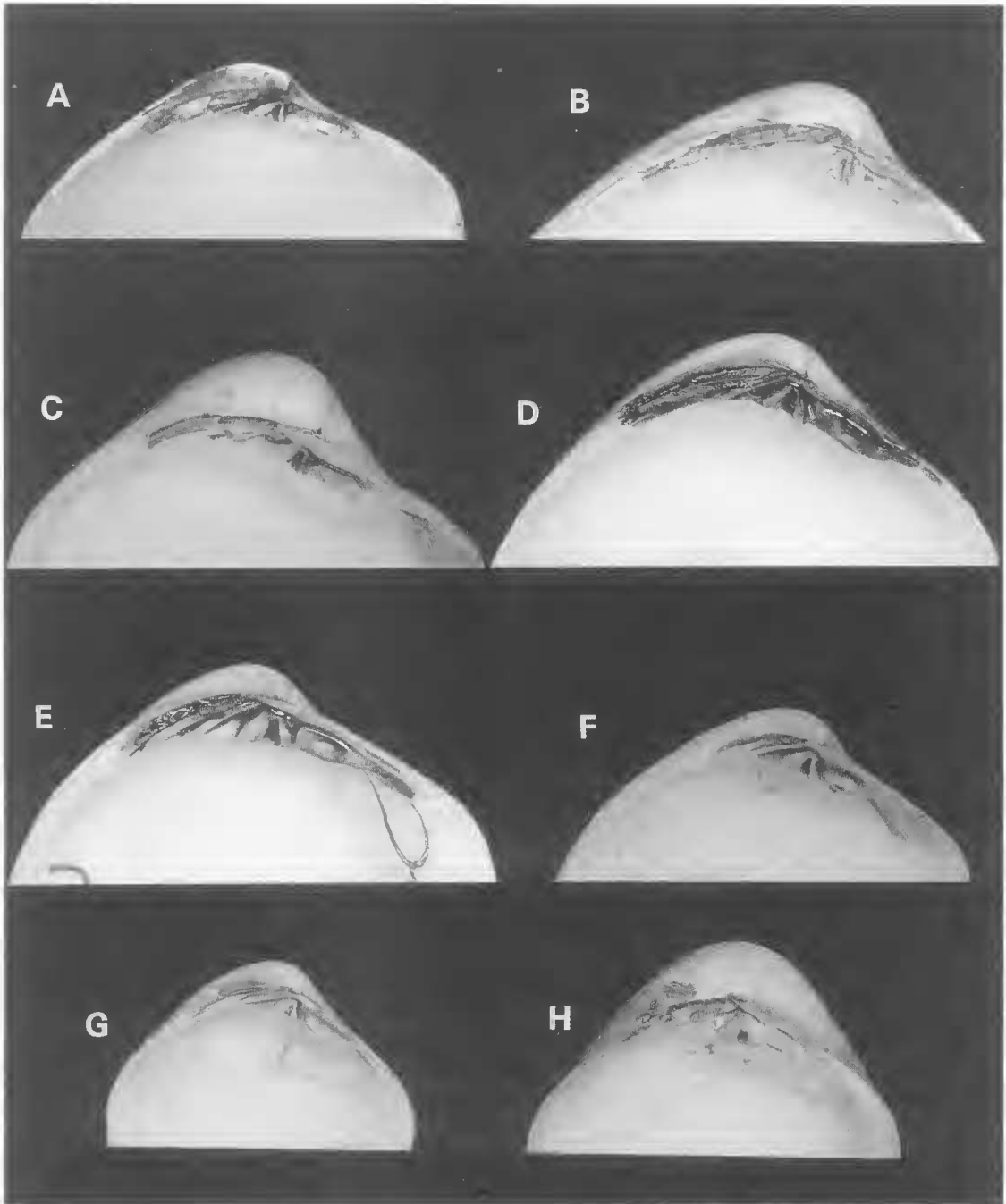


FIG. 10. Comparative hinge plate and teeth of rv. A, *P. (Pitarina) sophiae* (Angas), AMSC007545, Port Jackson, NSW, 23.2mm; B, *P. (P.) thornleyae* sp. nov., holotype, AMSC113277, Karumba, Gulf of Carpentaria, NEQ, 46.8mm; C, *P. (P.) lineolatus* (Sowerby), KL, Torres Strait, 24mm; D, *P. (P.) bullatus* (Sowerby), AMSC141214, Broome, northern WA, 36.2mm; E, *P. (P.) sulfureum* Pilsbry, KL, Kurrimine Beach, NEQ, length 28.9mm; F, *P. (P.) coxeni* (Smith), KL, Shelburne Bay, NEQ, 13.5mm; G, *P. (P.) regularis* (Smith), AMSC306561, Magnetic Is, NEQ, 15.5mm. H, *P. (P.) inconstans* (Hedley), AMSC073218, Madang, PNG, 22.1mm.

having coarser concentric lines and is less inflated than that species.

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